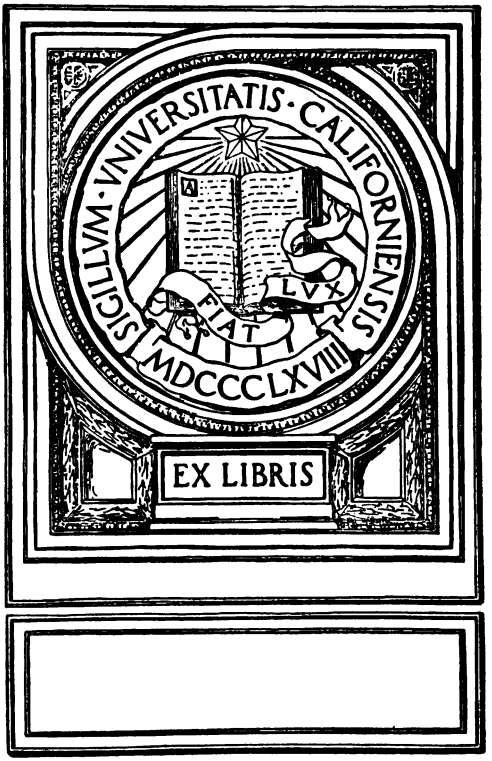
International

Fire Prevention Congress

London, England

1903



Compliments of
Ira H. Woolson

REPORT OF PROCEEDINGS

OF THE

INTERNATIONAL

FIRE PREVENTION CONGRESS

CONVENED IN LONDON, ENGLAND,

JULY 6th to 11th, 1903.

PREPARED AT THE REQUEST OF

JACOB A. CANTOR,

President of the Borough of Manhattan.

BY IRA H. WOOLSON, E. M.,

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Official Representative for the City of New York.

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COLUMBIA UNIVERSITY,
DEPARTMENT OF MECHANICAL ENGINEERING,
OCTOBER 20, 1903.

To the Hon. JACOB A. CANTOR,
President of the Borough of Manhattan,
New York City:

SIR—Acting under the authority vested in me by the City of New York under terms of a commission granted by his Honor Mayor Seth Low in compliance with a request from yourself, together with the four other Borough Presidents, I attended the International Fire Prevention Congress which convened in the City of London, England, in July last, as the City's representative, and participated in the proceedings. I have the honor to submit the following report:

REPORT OF PROCEEDINGS BRITISH FIRE PREVENTION CONGRESS.

HELD IN LONDON, JULY, 1903.

There were about 700 delegates present at the Congress, representing 16 separate governments (Great Britain, United States, France, Germany, Russia, Belgium, Holland, Italy, Denmark, Norway, Greece, Austro-Hungary, Chili, Mexico, Persia and Turkey); also a large number of cities and other corporations, fire brigade associations, chambers of commerce and similar public bodies.

The regular work of the Congress began on the morning of July 6, and continued for five days, the last day being devoted to inspection of the Testing Station of the British Fire Prevention Committee and observing fire-tests.

To facilitate the work, the Congress was divided into six (6) sections, as follows:

Section I.—Building Construction and Equipment (in which I had the honor to act as one of the Chairmen).
Section II.—Electric Safe-guards and Fire Alarms.
Section III.—Storage of Oils and Spontaneous Combustion.
Section IV.—Fire Survey and Fire Patrols.
Section V.—Fire Losses and Fire Insurance.
Section VI.—Fire Tests and Standardization.

Papers were read and discussed in the section to which they more properly belonged.

Thirty-eight papers in all were presented, including one on the subject of Fireproofed Wood, read by myself.

From these papers I have selected those having direct relation to the work of the Building, Fire and Police Departments of a city, and submit them as an incorporated part of this report. Some are given entire, others by extract, and are accompanied in each case with all the pertinent Congress discussion of the same. The balance are filed as documents of record.

These papers represent practice in various large cities of the world, and the conclusions and suggestions of recognized experts regarding fire prevention; as such they are valuable contributions to the literature of this vitally important subject. They are worthy of study, not only by city officials, but by builders, property owners, insurance companies, or any one who has responsible care of buildings.

Containing, as these papers do, a record of existing conditions, good and bad, in the cities to which they refer, together with their author's opinions, based upon the application of these conditions, it is not unlikely the information contained may prove equally valuable as a warning what not to do, as an incentive what to do.

It is highly probable they may be of most value to cities less progressive than New York in the investigation of prob-

lems of fire protection, but this does not detract from their worth as a part of our city's records.

There were several papers discussing the fire prevention question from the insurance point of view, which are worthy of careful perusal; but lack of space, and the fact that they have only an indirect relation to the work of our city departments prevented their incorporation in this report. Among these, special attention is directed to the following:

" Prevention of Loss by Fire in U. S." G. Edward Atkinson, Pres. Boston Mutual Insurance Co.

" Insurance Practices in U. S." Chas. Hexamer, Pres. Nat. Fire Prot. Ass'n, U. S. A.

" Fire Insurance and its Influence upon Fire Risks." C. E. Noverre, London, Manager, Norwich Union Fire Ins. Society.

" Fire Prevention through Schedule Rating." H. Wilmerding, Sec'y Philadelphia Underwriters' Association.

" Standards for Town Water Supply." F. M. Griswold, Gen. Inspector, Home Ins. Company, N. Y.

" Prevention of Accidents with Petroleum Lamps." Dr. B. Redwood and J. H. Thompson, Chief Inspector of Explosives, London.

Owing to the general heavy method of construction prevalent in European countries, and the comparative absence of steel construction as practised in America, their building laws are necessarily quite at variance with ours, but in all main essentials as regards fire protection they are much the same, though we are undoubtedly far ahead of them in the matter of compulsory fire protection laws.

The contrast between London and New York in this particular is quite marked. In the former city the control of building operations is vested in a body of men known as the " London County Council," and they seem to be a conservative and unprogressive organization, certainly in regard to fire preventive measures. I am informed that little or no restriction is placed upon the method of construction or material

employed, so far as protection from fire is concerned. Factory buildings are not required to be built fire-resisting, and there is no law compelling the use of non-conductive coverings for steel construction work and cast-iron columns. They make no practical tests of so-called "fireproof constructions," and ignore through petty jealousy the very valuable work in this line being done by the "British Fire Preventive Committee," which works "for the good of the cause," independently of city organization.

This condition of affairs is in strong contrast with the splendid work which has been done by our own Building Department in the practical testing of all fire-resisting materials offered for use, and in the formulating and enforcement of laws controlling their use when once accepted. This should be a cause of civic pride and congratulation.

In the methods of fire-resistant construction of large buildings, especially in the protection of steel and iron framework, America is undoubtedly ahead of the world, and New York City has probably done more investigative work in this direction than any other city in America. The work, however, is only well begun; much remains to be done before the public will be justified in believing that a so-called "fireproof building" is as safe as claimed, or as safe as it is possible to make it.

A large percentage of the delegates were representatives of fire brigades' unions and city fire organizations. They took an active part in the work and offered very valuable criticisms and suggestions. They were a finely organized, intelligent body of men, and without doubt brave and efficient, but it is doubtful if any body of firemen in the world are equal to the New York City firemen for alacrity and efficiency. I saw a number of contests between various fire organizations of England, and although they made a good appearance and did creditable work, it lacked the snap and effectiveness of our American organizations. This was not the fault of the men who composed the various fire companies, for they were a splendid lot of fellows. The trouble was due to the conservative system under which they worked.

It is said that the majority of London firemen were first seamen, having spent from one to ten years upon the water. There is an official preference for seamen in recruiting, and young men who desire to enter the fire brigade service very often take a year or two at sea as a preparatory course. In many ways the training of a sailor is claimed to be peculiarly fitting for the making of a good fireman, especially " as regards discipline, and being accustomed to long and irregular hours," as well as being trained to work at great heights.

The dangers confronting the firemen abroad are far less than those of New York for two main reasons. First, the absence of tall buildings, and second, the custom, even in small structures, of building solid brick partition walls and stone and brick stairways which greatly aid in confining a fire to a limited area. Nevertheless, great fires do occur continually, and the authorities of all countries appear to be fully alive to the importance of adopting the best preventative measures possible in the construction and management of buildings, but they are conservative, inclined to be prejudiced, and consequently slow to adopt methods of protection which have practically become standard in this country. Two notable examples of this, particularly in London, is their very limited use of the automatic sprinkler and chemical fire engine.

Two afternoons of the week were spent inspecting the Testing Station of the British Fire Prevention Committee. Tests of armored doors and solid wooden floor construction were observed. It is the most admirably arranged and equipped plant I have seen, and they are doing splendid work, but from my intimate knowledge of a large number of tests conducted under the supervision of the Building Bureau of this city, I would unhesitatingly say that the severity of the test they apply is not so great as that adopted here.

The Congress placed itself on record as strongly advocating the establishment of permanent testing stations in various countries where tests could be made under accepted standard conditions decided upon by an International Fire Prevention Bureau, so the results of tests at one station would be accepted by all. It is to be hoped that a station of this character may

be eventually established in or near this city, where tests may be regularly made under standard conditions by independent authorities, whose results could be accepted without cavil.

The Building Bureau's work in this direction is very carefully and conscientiously done, but owing to the great disadvantage of the changing conditions under which it works, it is extremely difficult to bring results to a common standard, besides making the individual tests much more expensive than they should be.

They have this testing station in London; also one in connection with the Technical High School in Berlin, and one is being constructed in St. Petersburg and another in connection with the Boston School of Technology. New York should be abreast of the times in this very important field.

For convenience of consultation the papers appended are arranged under the heading of the section in which they were presented, and following them is a list of general resolutions adopted by the Congress. It is not certain that these resolutions are all worded exactly as they were finally passed. A few of them were slightly altered by amendment at the last moment, and I have been unable as yet to get a verified copy of these amendments; however, if there are any inaccuracies they are of minor importance and will not change the general proposition.

In conclusion I desire to express my high appreciation of the extremely cordial and generous reception tendered me by the Congress officials in my capacity as the city's representative, which included the honor of appointment as a chairman in the most important section of the Congress. And I further desire to express the hope that the pleasant relations thus established may serve as an incentive to the city authorities to insure its proper representation at any future meetings of the Congress, thereby keeping pace with the world's progress in this important line of investigation.

Yours very respectfully,

IRA H. WOOLSON, E. M.

INTERNATIONAL FIRE PREVENTION CONGRESS

HELD IN

LONDON

JULY 6TH TO 11TH, 1903.

Congress opened by THE RIGHT HON. THE LORD MAYOR.

General remarks by Provincial and Foreign Delegates.

General Addresses.

EDWIN O. SACHS, *Chairman.*
Address upon the work of the Congress.

G. EDWARD ATKINSON, LL. D., President, Boston Manufacturers' Mutual Insurance Co.,
"Prevention of Loss by Fire in the United States."

GUY PYM, M. P., London,
"The Necessity of Placing Fire Brigades on a Sound Legal Basis."

Papers Read.

SECTION I.

BUILDING CONSTRUCTION AND EQUIPMENT.

PRIVY COUNCILLOR J. STÜBBEN, late *President* Almg. Societies of German Architects and Engineers; late City Surveyor of Cologne.
"Stadtplan und Bauordnung, in Bezug auf Feuerschutz."
["Municipal Fire Protection as influenced by Street Planning and Building Regulations."]

FIREMASTER PORDAGE, Fire Brigade, Edinburgh.
"Building Construction from the Fireman's Point of View."

CHIEF OFFICER WESTPHALEN, Hamburg City Fire Brigade.
"Moderne Lagerschuppen und Speicher in Hamburg."
["Modern Warehouse Construction at Hamburg."]

MAX CLARKE, A.R.I.B.A., London.
"How to make existing London Buildings more Fire-resisting."

B. DICKSEE, District Surveyor, London.
"Fire Preventive Sections in the London Building Act."

ELLIS MARSLAND, District Surveyor, Camberwell, London.
"The Planning and Arrangement of large Retail Commercial Establishments."

A. B. MARKUSOWSKI, Adjutant, City Fire Brigade, Budapesth.
"Some Notes on Fire Prevention, having particular regard to Theatre Safety."

SECTION II.

ELECTRICAL SAFEGUARDS AND FIRE ALARMS.

ALEXANDER SIEMENS, *Past President,* Inst. of Electrical Engineers.
"Safety and Control Arrangements for Fire Alarms."

G. H. OATWAY, London.
"The Necessity of Automatic Fire Alarm Systems."

E. C. DE SEGUNDO, A.M.Inst.C.E.
"Electric Wiring and Electric Risks."

HIP. CAZIER, Creil, Vice-President, Int. Fire Brigades Council.
"Electrical Risks in Theatres."

ALFRED HANDS, F.R.Met.S., London.
"Necessary Practical Safeguards against Lighting."

SECTION III.

STORAGE OF OILS AND SPONTANEOUS COMBUSTION.

CAPTAIN J. H. THOMSON, H.M. Chief Inspector of Explosives, London.
"The Storage of Explosives, Petroleum and certain Chemicals within densely inhabited areas."

P. DVORKOVITZ, Principal the Petroleum Institute London.
"The Necessary Safeguards for the Prevention and Spread of Fires in Petroleum Stores."

DR. BOVERTON REDWOOD, Advisor on Petroleum to the Home Office, and Captain J. H. THOMSON, H.M. Chief Inspector of Explosives.
"The Prevention of Accidents with Petroleum Lamps."

PROFESSOR WOOLSON, Columbia University, New York.
"Fireproofed Wood as a Building Material." With Experiments.

PROFESSOR MEDEM, University of Greifswald.
"Selbstentzündung." ["Spontaneous Combustion."] With Experiments.

F. W. HARDWICK, University College, Sheffield.
"Underground Fires."

SECTION IV.

FIRE SURVEY AND FIRE PATROLS.

W. H. HUNTER, Engineer-in-Chief, Manchester Ship Canal.
"Fire Patrol Service for Dock Property."

A. DITTMANN, Chief Officer Bremen Fire Brigade.
"Die Einwirkung der Feuerwehr auf die allgemeine Feuerverhütung." ["The Influence of the Fire Service on Fire Prevention."]

J. DE BOLCS, Departmental Councillor, Home Office, Hungary.
"Some Notes on the General Fire Preventive Measures Adopted in Hungary, having primary regard to rural townships and villages."

D. W. REUTLINGER, Editor "Feuer und Wasser," Frankfurt a/M.
"The Value of having Professional Reports upon Fires with the View of Instructing the Public."

GORHAM DANA, Inspector Underwriters' Bureau, New England, Boston, U. S. A.
"The Care of Private Fire Appliances."

A. GOLDONI, Chief Officer, Fire Brigade, Milan.
"Du Service de Vigilance et de Prévoyance dans l'Intérieur des Théâtres pendant la Représentation." ["Fire Survey and Fire Watches in Theatres during performances."]

R. CZERMACK, Hon. President Austrian Fire Brigades Association.
"Die Fachliche Erziehung freiwilliger Feuerwehren in Kleineren Staedten u. auf dem Lande im interesse der Feuer Verhütung." ["The Question of Technical Instruction for Volunteer Fire Brigades in the interests of Fire Prevention."]

SECTION V.

FIRE LOSSES AND INSURANCE.

CHAS. HEXAMER, *President,* National Fire Protection Association, U. S. A.
"The Principles of Fire Insurance in the United States."

C. E. NOVERRE, *London Manager,* Norwich Union Insurance Society.
"Fire Insurance and its Influence upon the Reduction of Fire Risk."

H. WILMERDING, Secretary Philadelphia Fire Underwriters' Association.

"Fire Prevention through Schedule Rating."

W. H. STRATTON, Chairman of Executive, National Fire Protection Asso., U. S. A.

"Fire Hazards in America from an Insurance Point of View."

J. SHEPPARD, North British and Mercantile Insurance Co., London.

"The Importance of Official Investigation and Statistical Research into the Causes and Extent of Fires."

F. M. GRISWOLD, General Inspector, Home Insurance Co., New York, U. S. A.

"Standards of Town Water Supply and Fire Protection from the American Insurance Point of View."

SECTION VI.

FIRE TESTS AND STANDARDIZATION.

W. H. MERRILL, Jun., The Underwriters' Laboratories, Chicago.

"The Testing Principles adopted at the National Fire Prevention Laboratory of Chicago."

CROWN ARCHITECT JAFFE, Berlin.

"The Testing Principles adopted in the Royal Technical Research Laboratory, Charlottenburg, and at other Fire Tests in Germany."

EDWIN O. SACHS, *Chairman,* British Fire Prevention Committee.

"Suggested Standards of Fire Resistance."

CHIEF OFFICER WELSCH, City Fire Brigade, Ghent.

"Necessite d' une methode unique universalle pour l'essai de resistance au feu des materiaux de construction." ["The Need for a Uniform Method of Testing the Fire Resistance of Building Materials."]

GENERAL MEETING.

THE CONGRESS ADDRESS.

By Edwin O. Sachs,

Chairman, British Fire Prevention Committee,
Vice-President, National Fire Brigades Union.

INTRODUCTION.

This Congress is intended to deal principally with that primary side of Fire Protection indicated in its title, namely, *Fire Prevention.* Fire Protection, as I trust all concerned will soon understand it, comprises *Fire Prevention* and Fire Fighting combined. Fire Brigade gatherings and Fire Tournaments have frequently been organized with the object of exchanging experiences relative to the fire service, progress in matters of fire brigade equipment, and the training of firemen; but whilst we have had many such meetings of firemen (one recently at Berlin, which also dealt with the preventive side to a considerable extent), the *world has never yet seen a Fire Prevention Congress,* or a conference of all those who are interested in *precautionary measures for preventing the outbreak and spread of fire,* as distinct from fire extinguishing and actual life-saving. Never before in this country has a gathering been held at which architects, engineers, surveyors, municipal officials, legislators, insurance officials and fire surveyors have met to take council with Fire Brigade Chiefs and Salvage Corps Officers.

From the earliest times efforts of a kind have been made to reduce fire risk in connection with buildings, mainly with the view of preventing the spread of fire from house to house. With the rapidly increasing fire hazards of our great communities, however, it is necessary that increased importance should be accorded to the fire preventive side of constructional work,

and, above all, to precautionary measures against the outbreak of fire and to safeguards against its rapid spread within the bounds of a single ownership.

Professional Interest in Fire Prevention.

It is only recently that members of the professions concerned have become keenly alive to the importance of this precautionary or preventive side, recognizing its value to the community for the safety of life and the economy of our national wealth. It is even at a more recent date that a few of the leading members of the British fire service have awakened to the fact that a fire brigade officer's work not only consists in extinguishing fire, but must to a great extent include a sound knowledge of precautionary measures.

Representative Character of the Congress.

It is hence of happy augury that at this, the first Fire Prevention Congress, the representation of the various professions concerned is approximately proportionate to their relative interest in the subject of Fire Prevention, for on classifying the members of this conference we find but few branches which have not come up to the standard of representation which an occasion of this kind demands. It is particularly pleasing to observe how strongly the interests of the municipalities and local authorities are represented.

The Initiation of Fire Preventive Measures.

General preventive measures may be the result of private initiative, but as a rule they require to be defined by Government or local authority in Building Laws, Fire Protection Acts, Fire Survey Regulations, or, as in the United States and many Continental countries, set out in the publicly recognized schedules of Insurance Companies and Mutual or Municipal Insurance offices. They are frequently supplemented by special rules for the treatment of extraordinary risks, such as the storage of petroleum, the manufacture of explosives, the presentation of stage plays, or the installation of electric power and light. These preventive measures are as a rule initiated

and at times facilitated by the work of learned institutions or technical societies, such as The British Fire Prevention Committee.

The Conveners of the Congress.

This Congress is convened by the Executive of the British Fire Prevention Committee, a body whose main objects are to direct attention to the urgent need for increased protection of life and property from fire by the adoption of *preventive* measures, to use its influence in every direction towards minimizing the dangers of fire and to bring together those scientifically interested in the subject of fire prevention.

The Committee was founded at the time when the terrible loss of life at the Paris Charity Bazaar fire of 1897 still haunted the public mind, and the enormous destruction of property in the Cripplegate area in London had made a deep impression both at home and abroad. In the five years of its short life the Committee has done much work in testing materials and circulating publications, but on no occasion has it put forward such an ambitious programme as when it attempted to organize this conference.

The Scope of the Congress.

What this conference is intended to do may be understood from the definitions of the objects of the Congress set out below, and if the thirty-six papers to be read, with the discussions thereupon, lead to a part only of those objects being attained, and if only a few public declarations of their general views be made by those most interested, the conveners will be satisfied that something useful has been accomplished. To expect any immediate public action, however necessary, as the outcome of the Congress work would lead to disappointment, but our deliberations will, I trust, result in laying well and truly the foundations of several important reforms in the near future.

THE OBJECTS OF THE CONGRESS.

The objects of this Congress are:

(*a*) To consider the practice of building construction and the application of building materials from a fire-preventive point of view; comparing the practice in different countries, and inquiring into the latest materials and systems of construction available, as well as the latest inventions for the general equipment of buildings.

(*b*) To consider the equipment of buildings, particularly in relation to the application of electric power and electric light, eliciting the views of electrical engineers and fire brigade officers as to the origin and prevention of electrical fires, including safeguards against fires caused by lightning.

(*c*) To consider the development of ordinary and automatic electrical fire-alarm systems and their application.

(*d*) To consider the legislative enactments in force in cities and districts, particularly in respect to the limitation of area or cubical contents for warehouse buildings and workshops, and the means of separating and uniting such buildings, also the means of escape in case of fire, likewise the regulations governing the construction and control of theatres and places of public resort, and the means of escape in case of fire in shops and tenements.

(*e*) The best means of watching or inspecting buildings and plant exposed to fire risks without undue inconvenience to owners and occupiers, the practice of fire brigades in this direction, and the experience of the various fire-patrol systems.

(*f*) The latest experience as to spontaneous ignition and safeguards for the storage of explosives and oils; the practice in respect to insurance against fire; the systems adopted in various countries; the risks insured against; the relations of national, municipal, public and private insurance corporations; systems of mutual

insurance; the precautions taken against incendiarism; the statistical recording of fire losses; and the preparation of uniform fire maps and plans.

(*g*) The best means of recording and tabulating the causes and also the effect of fire, and from a comparison thus obtained, compiling standards for various degrees of fire resistance required in different buildings and suited for various materials; also the best methods of testing materials and recording the facts of such tests for the information of those engaged in the construction, use and protection from fire of buildings.

PART I.

Some Congress Problems.

It is not my intention to deal with the objects of this Congress in detail, as many of the questions involved will be treated much more ably in the papers of which you have a list before you, and an analysis of the points at issue would lead far beyond my intention in making these introductory remarks.

But I will venture to set out on this occasion a few of the general matters which I hope may be influenced by this Fire Prevention Congress.

An International Centre for Fire Preventive Work.

A. I trust that this gathering will, in the domain of Fire Prevention, lead to that regular interchange of experiences aimed at by the International Fire Brigades Council in Fire matters, and that societies, institutions and laboratories occupied solely or partially with Fire Prevention will create some centre for the exchange of views and results. In other words, I trust the day is not far distant when there will be an International Fire Prevention Bureau as there is already an International Fire Brigades Council. Such a Bureau would not be a decorative or ornamental institution, but a small technical working committee for the exchange of opinions, and, above all, for the standardization of results, so that, for example, a

manufacturer who has had a fire-resisting material tested in the United States by a body affiliated to the Bureau will know that that same test will have the recognition of similar bodies in other countries. London having been (thanks to the British Fire Prevention Committee) the pioneer in the Eastern Hemisphere for systematic work in this direction, and being in such close touch with the great cities of the Western Hemisphere—where so much good work has long been done—will, I trust, be selected for the seat of an International Bureau of this description.

Standardization of Fire Resistance.

B. Regarding the standardization of Fire Resistance for practical purposes, an attempt will be made at this Congress to draw up standard tables that shall at least be used in the United Kingdom, and which we trust may also be adopted in foreign countries. The calculations in that case being on the Metric system.

Wrongful Trading on the Term "Fireproof."

C. Hand in hand with this question of standardizing tests will come the banishment of those fraudulently-disposed traders who, under the description of "Fireproof," try to palm off on unwary builders, architects and landlords spurious materials and unsafe systems of construction, which should be condemned as sharply as any other attempted trade fraud. These purveyors should be equally liable to a penalty with the man who tries to palm off unsound food for human consumption. Surely nothing is more terrible than the idea that the landlord of a block of chambers or of a tenement-house should have been gulled into the use of materials and systems of construction which, at the first outbreak of fire in any room, might bring about the collapse of numerous offices or tenements, and thus occasion great loss of life. In other words, I trust that this Conference may take the first steps toward making it illegal to sell unsafe materials under the name of "Fireproof." It is a sad fact that firemen of long experience have come to look upon buildings described as "Fireproof"

with particular repugnance, as sources of special danger which take them by surprise; you will hear nearly every fireman in England, and, I believe, many on the Continent, tell you that they always prefer to deal with an old-fashioned timber building rather than the latest new-fangled erection in which perhaps the whole structure suddenly collapses, either because the system of floor construction sold as " Fireproof " fails, or because some partition they have relied upon to shield them disintegrates the moment the water is applied.

ABOLISHING THE ERRONEOUS TERM " FIREPROOF."

D. It is to be hoped, in fact, that among the various objects in the promotion of which this Conference should bring some influence to bear, may be the exclusion of the word FIRE-PROOF from the vocabulary of the English and American nations; the word is a misnomer; fireproof is a term for something which is almost non-existent, and certainly does not exist in ordinary building practice; the sooner it is banished the better, and, as will be seen from one of the papers to be read here, it is the Committee's intention always to substitute the word FIRE-RESISTING, and further to discriminate between the different classes of Fire-resistance, whether the system of construction be intended for temporary protection, partial protection, or the fullest protection obtainable in practical circumstances.

THE ADMINISTRATION OF FIRE PREVENTIVE LEGISLATION.

E. It would be useful if this Conference brought municipal authorities to recognize that by building regulations alone the necessary standard of safety in towns cannot be obtained. Building regulations must be supplemented by regular fire surveys or fire patrols, as practised particularly in America and Northern Europe, with the view of obtaining preventive measures in the equipment and use of buildings, and at the same time preventing the neglect of existing means of protection.

Retrospective Fire Preventive Legislation.

F. It would be well also if the Congress led to municipalities recognizing that certain building regulations should be made retrospective, ample time, however, being allowed the owner to effect the necessary improvements and to solve the financial problem thereby entailed.

Retrospective legislation is by no means a novelty in other spheres of the world's work, or, as a matter of fact, in such an allied subject as the prevention of accidents from machinery or in mines.

Fire Preventive Instruction in Elementary Education.

G. It is desirable that this Conference should lead the various authorities dealing with elementary education to consider the advisability of including special tables and copy-book headings in the ordinary curriculum, with the view of instructing young children in the dangers of fire, and instilling in them a wholesome prudence which will remain with them throughout their lives.

Attention to these matters, as also to fire drill for children, would give future generations a far greater interest in questions of fire risk and fire prevention.

Speaking of schools, the Congress might well draw the attention of those concerned to the necessity of extending the existing forms of special regulations for theatres or factories to other classes of buildings where many assemble, and which form special risks. In referring to schools, I mean both day and public schools, for rich and poor alike. The housing arrangements as tolerated at Eton and many other schools would not be tolerated in a common lodging-house.

The Prevention of Electrical Fires.

H. The Conference could perhaps assist in impressing upon municipal officials, architects and fire brigade officers, the constantly increasing hazards of the electrical risks in every direction, not least among the new hazards being those connected with high tension systems and the installation of

power plant. With the increase of electric lighting, installed by inexperienced artisans, such as plumbers or gasmen, who have simply picked up some slight knowledge of their work, the danger of fire from this direction is rapidly on the increase and bids fair to rival that from open light illumination.

INQUIRY INTO THE CAUSES OF FIRE AS A PREVENTIVE.

I. The Conference would likewise do a good work if it drew attention to the necessity for more numerous fire inquiries, with the aid of skilled advice and a more careful examination into the causes of fire with the view of finding and advocating the necessary remedies. Combined with any system of inquiry there should be a central system for recording the results of these investigations with the view of producing data of statistical accuracy.

THE INFLUENCE OF FIRE INSURANCE AS A FIRE PREVENTIVE.

K. Another matter to which the Conference might draw attention, having special regard to the visit of our American friends, is the great influence which the Insurance Companies can have on the reduction of the national fire loss without in any way decreasing the extent of their business, but rather adding to their margin of profit. It is essential for the economic development of our large cities that substantial encouragement should be given by the Insurance Companies to better building, and this even regardless of what is generally known as the " block rate " risk for particularly hazardous areas, as it is just the substantial building well placed that serves as one of the best fire stops in dangerous districts. Several members of the great Insurance Corporations are to be congratulated on their progressive action in recent years for the encouragement of better building by at last publishing their requirements as to specific classes of risks, but it is essential that this encouragement should be extended and systematized in such a manner that the owner of the building may be able to understand clearly before he starts operations the exact financial advantage of careful construction for all the more important classes.

In emphasizing the above point, I think I should, in common fairness to the Fire Insurance Companies, take the opportunity of condemning as absolutely illogical the contention often published that it is the duty of a fire insurance office to contribute toward the cost of fire brigades. Assuming, however, that it was the duty of an Insurance Company to support the fire-fighting forces, the insurer would have to make up his mind to pay the Insurance Companies for this assistance, just as he now has to contribute to the rates for the maintenance of the fire service provided by the public authorities, or subscribes voluntarily to a volunteer or private fire service, which are not officially supported. I should add that it would probably cost him more to pay for his fire service through the Insurance Companies, inasmuch as the latter would be entitled to make a profit as payment for the time devoted to this matter of providing a fire service, and also on the financial turnover involved.

Fire Intelligence.

Another subject that requires earnest consideration from this Congress is the necessity for great care in the installation and inspection of the facilities for calling fire brigades to a fire. Whilst rapid advance has been made in the diminution of the number of seconds in which a fire brigade when called is able to turn out, attend and turn water on a fire, the means of calling the brigade, though greatly improved, do not seem to have received their due attention. I would particularly call the attention of the Conference to the pros and cons of the various automatic fire alarm systems for signaling danger. I would also recommend the discussion of the policy of giving rewards for an early call to a fire and the selection of conspicuous sign posts to indicate the position of call points.

PART II.

Fire Service Co-operation in the Congress.

Although the Congress, as I have been at pains to explain, is essentially a Fire *Prevention* Congress, dealing with pre-

ventive and precautionary measures, the opportunity has, I am glad to say, been taken by many fire brigade officers and by the leading organizations of the Fire Service (which are strongly represented on this occasion) to hold several meetings at our Congress Bureau. Thus this Bureau will be the scene of the bi-annual business meeting of the very useful International Fire Brigades Council, comprising the accredited representatives of a large number of countries. A two days' meeting of the newly formed Association of Professional Fire Brigade Officers of the British Empire will also take place at the Congress Hall, one day being devoted to business and one to lectures, whilst the National Fire Brigades Union will hold their nine days' Tournament, with their highly instructive Exhibition drills and competitions in connection with the Congress, arranging their events in such a manner that some of the most important can be attended by members at the close of the Congress week.

The Effect of the Status of the Legal Fire Service on Fire Prevention.

For the purpose of Fire Prevention, the standing of the Fire Brigade Officer, his training and technical knowledge, his general education and ideals, are matters of importance, and although the British Fire Prevention Committee has nothing whatever to do with the internal management and equipment of the Fire Service, it welcomes every move in the Fire Service that tends to efficiency in this direction. The main efforts of Fire Brigade officers who wish to bring their influence to bear in favor of Fire Prevention must, however, in the first instance, be mainly directed to secure the recognition of the fire service as a public institution, and a definition of the duties, status and legal responsibilities of all Fire Brigades, whether paid, part paid, volunteer or private. With the higher standing of the Brigades comes the greater influence of their officers. The establishment of the Fire Service, both volunteer and professional, in a sound legal and responsible position, which has been achieved in other countries by Fire Brigade Federations, is now being brought about in this country, mainly

through the efforts of the National Fire Brigades Union, and I need not add that everything that can be done by the British Fire Prevention Committee, as conveners of this gathering, to assist the Union, has been and will be done. It is for this reason that we have, after careful consideration, included a Paper on Legislation for Fire Brigades in our programme, and we shall also hear other Papers read which, whilst intentionally avoiding all matters of internal fire service management, touch on the relation of the fire brigade officer to matters of fire prevention and survey.

The Fire Service and Building Construction.

It would be well if municipal authorities after this Conference were to encourage the younger generation of fire brigade officers to take a more active interest in the constructional and engineering side of buildings and works. As the protection of hazardous property is becoming more and more technical, much depends on a quick recognition of the construction of a burning building and the adjacent property in order to prevent the spread of the blaze to adjoining risks.

The Fire Service and Fire Topography.

It would also be well in the interest of fire prevention if greater attention could be accorded by fire brigade officers to what is more generally known as fire geography or topography; in other words, the careful study of the locality with a view to ascertaining its structural risks and dangers arising from the contents of its buildings. The map-making encouraged of late years by British fire insurance officers, and so long popular in American and Canadian insurance circles, shows what insurance men think of the value of such topographical knowledge as an aid to separating and diminishing their financial risks. Practically the whole of the information embodied in such maps for insurance purposes is serviceable to the fire brigade officer, on whose local knowledge and ability to make a quick reference so much frequently depends.

Consolidation of the British Fire Service.

Here I would ask you to permit me to give expression to a desire cherished in many quarters.

It is common knowledge that the professional and volunteer fire services, as represented by many of the members of the Professional Association and the National Union, do not work together with that harmony which is of such importance to the welfare of the community at large. In making the arrangements for this Congress the officials of my committee and I have had constantly put before us questions arising from the relations between the officers of the professional and volunteer services.

I trust this gathering will give an opportunity for some arrangement by which wholly unnecessary tension (which is common to several countries with our own) may be ended; and I venture to suggest, as a first practical step, that it would not be an inopportune moment for some of the leading representatives of the different societies to meet and organize a small council on which the bodies mainly concerned could be represented, with other kindred bodies, such as the London Private Fire Brigades Association, etc. Such a council would serve for the discussion of matters that concern all firemen, whether professional or volunteer, and would help to bridge over what is at present a somewhat nasty chasm. A small permanent bureau like this, with an independent chairman, would, I am sure, do a great deal of good, and would in time become a recognized fire service centre.

CONCLUSION.

The Popularizing of Fire Prevention.

Whilst the work of the Fire Prevention Committee will, I trust, continue to be in the main of a technical and scientific character, I hope this Congress will give an impetus to the popularization of fire prevention. I would be glad to see as an outcome of this gathering a National Fire Prevention League, under the auspices of the committee, which should

become as generally popular and as useful to the nation as the Navy League, whose value is, I believe, generally admitted, even by those who do not agree with its methods. The subject of fire prevention must be popularized, and this is only possible by so widening the field of our efforts so that the man in the street, the property-owner, the warehouseman and the manufacturer shall take an active, personal interest in reducing the annual loss of life and wastage.

SECTION I.

MUNICIPAL FIRE PROTECTION AS INFLUENCED BY STREET PLANNING AND BUILDING REGULATIONS.

By J. Stübben, *Privy Councillor of Cologne.*

(Translated from the German.)

Extracts.

The laws of the German States always have provisions controlling the arrangement and laying out of city streets, so they may best expedite traffic, preserve public health, and promote safety against fire.

Plan and Width of Streets.

All buildings must be so located as to be easily accessible from the street for fire extinguishing apparatus. The plan of the streets must be simple in order to facilitate the labors of the firemen. The width should be such as to prevent, as far as possible, the spread of fire from block to block. Main avenues should be from 30 to 50 meters wide, and the clear width of side streets should not be less than 10 meters, except in rare cases with houses having yards in front, when the width may be reduced to 8 meters. The use of narrow streets and alleys is to be condemned as a menace to safety. Crooked streets which obstruct a free view are to be avoided, but gentle curves are beneficial as well as beautiful.

Abstracts from the Building Laws.

Location of Buildings.

Buildings located back from the street line must be provided with an unobstructed fireproof driveway. In Berlin and Mannheim if the building is over 30 to 40 meters back from the street a similar free driveway to the rear of the buildings must be provided.

Size of Courtyards.

Size of courtyards and width of stairways are also matters of regulation.

For courtyards the minimum width allowed varies in different cities. For small houses in Cologne it is 2.5 m. In

Berlin 6 m., and in Berlin suburbs 15 m. The minimum surface area is 24 sq. m. in Posen, and 60 sq. m. in Berlin. The yard must also bear a certain proportion to the area of the building lot. The general average for the German States is, width 5m., area 40 sq. m., and proportion of surface 30 per cent. If a courtyard is covered with glass it must be strong enough to be walked upon.

Width of Stairways.

Small houses occupied by not more than two families, 90 c. m. are sufficient. In large houses with numerous families the stairways at the top floor shall be 1 m. wide and 15 c. m. wider on each floor below.

Number of Stairways.

The number of stairways is controlled, on the one hand, by the area of the building and, on the other hand, by its height. For example, if the general floor area exceeds 150 sq. m., two stairways are required. Or the same thing is accomplished in another way in certain cities, *e. g.*, in Mannheim no apartment may be further away from a stairway than 20 m., or in Cologne, no point in a building may be more than 30 m. distant from a stairway. The regulation as controlled by the height of building is that two ordinary or one fireproof stairway is demanded by law when an apartment floor is more than 8 m. above the street level.

The number of families also has a controlling influence upon the number of stairways. The law requires that one stairway shall not be used by more than three (3) families on a floor. Where the lower floors of a building are used for business with apartments above, separate fire and smoke proof stairways must be provided for the apartments, giving direct exit to the street or yard.

Construction of Stairways.

In small houses occupied by one or two families, and not over three stories high, oak stairs are allowed, or other wood if rough cast on under side. Where there are more than two stories the stairway must be enclosed in masonry walls. In large houses with numerous families, solid masonry stair-walls are always insisted upon, and if more than three stories high, the stair treads must be "non-burnable." These stairways must connect on the top floor with halls, which are separated from the rest of the floor by fire-resisting partitions. They must

have no connection with the cellar, nor with any room in which combustibles are stored.

What materials to use to make the stairs safe from fire is not a settled question. Faith in stone and iron has been greatly shaken in recent times. Casemated masonry and reinforced or trussed concrete are looked upon as fireproof.

Location of Buildings in Regard to Railways.

The least distant from the nearest track that the fire-resisting part of a building may stand is 4 m., and a combustible building not less than 25 m.

Gas and Electric Installations.

Gas-pipes must be placed accessible on walls and ceilings, and gas meters located in light, well ventilated rooms. Electric-light wires and fixtures should be installed subject to the rules of the German Electrical Engineers.

Lightning Rods.

Lightning rods are a source of danger instead of safety if not kept in perfect condition. The law therefore demands a yearly inspection of the rods by an expert. Lightning rods are considered a necessity upon theatres and all places of meeting.

Flag Poles.

Flag poles upon roofs are always to be constructed of sheet iron or steel and should be provided with approved lightning rod connection to the earth.

Carpenter Shop and other Dangerous Buildings.

Carpenter shops, and other woodworking rooms, bake ovens and like work rooms which are likely to catch fire, must be located in rooms with masonry walls and exposed on all sides.

Regulations Regarding Methods of Lighting.

In warehouses, petroleum lamps and movable gas jets are prohibited. Show windows must be illuminated only from the street or in such way that a thick glass plate shall be between the goods displayed and the lights.

Partitions and Cornices.

Partitions not bearing weight may be constructed of wood if they be rough plastered on both sides. Elevator shafts and light wells must be inclosed by fireproof walls which extend above the roof.

Cornices and exterior decorations must be either fireproof in themselves or covered with some fire-resisting material.

Fire Walls.

Between every two houses there shall be an unbroken "fire-wall" extending to a height of at least 30 c. m. above

the roof. The lack of these "fire-walls" and numerous unprotected doorways and alleys are responsible for the many destructive fires which occur in the old cities.

In large buildings, intersecting fire-walls are required at distances varying from 30 to 40 m. It is desirable that the different floors be solid and fire-resisting.

Warehouses.

Cellars must be completely shut off from the ground floors, likewise the top floor must have no direct connection with the business floors, and must be shut off from well-holes, to avoid danger from fire or smoke below.

All ceilings must be free from openings.

Around the gallery rails of light shafts a space of 1 to 2 m. shall be kept clear from all combustible materials.

Theatres.

A free space of 6 to 9 m. is required upon all sides of theatres and other buildings used for public meetings. All construction shall be fire-resisting, and the stage shall be cut off from the auditorium by an iron curtain. There shall be fire cocks and sprinkler system on the stage.

Fire hydrants with all necessary attachments are required both within and without all such buildings.

The seating capacity of theatres is under police regulations, but not more than four (4) galleries are allowed. Each gallery must have two (2) outside stairways. The width of these stairways is regulated by the number of people to use them. For 90 people or less, the width shall be 1 m. Over 90 people, the width shall be 1½ m. Where the theatre has adjoining buildings, there must be an outside gallery and stairways. All doors must open outwards.

No steps are allowed in the parquette aisles, and for 70 to 80 people must be at least 1 m. wide.

For the stage there must be two (2) fireproof stairways leading from the basement to roof. All rooms must face upon fireproof corridors, which must have two (2) openings or stairways, all well lighted.

Similar laws apply to concert halls and other public places. In all cases cross-passages or other means of congesting the main exit passages must be avoided.

Methods of Construction.

To prevent collapse of burning buildings, pillars of oak

(slow-burning) are recommended over use of iron or steel. The latter when used must be surrounded with some non-conductive covering. The Monier and Rabitz systems of covering, also terra cotta, are favorite methods.

Height of Buildings. In Berlin and suburbs 15 to 22 m. is allowed. In other cities about 11 m.

In no case is the height of a building to exceed the width of the street, at least not more than 1 or 2 m.

In Berlin no living apartments are allowed above a height of 17.5 m., and there are similar laws in other German cities.

The maximum number of floors devoted to living apartments varies in most cities from 4 to 5; in the suburbs only 3.

Rear dwellings are placed under severe restrictions.

Fire Escapes. All buildings devoted to a combination of manufacturing or business with living apartments or meeting rooms must have two fire and smoke proof stairways to the street. Fire escapes are sometimes required in addition.

SECTION I.

BUILDING CONSTRUCTION FROM A FIRE BRIGADE OFFICER'S POINT OF VIEW.

By Arthur Pordage, *Firemaster of Edinburgh.*

Extract.

" In taking up as my subject ' Building Construction from a Fire Brigade Officer's Point of View,' I have clearly before me the fact that most architects and builders are fully alive to the necessity of fire-resisting construction, and that legislative and local enactments make stipulations and recommendations with the view of preventing destruction by fire. Such efforts are worthy of praise; but my experience in combating fire leads me to the conclusion that what is intended as a safeguard too often becomes a danger, and what is theoretically meant for strength is found in the hour of need a source of weakness.

" What I propose to deal with is the type of building usually described as being constructed entirely ' fireproof,' and to offer from my practical every day experience suggestions which may perhaps induce building constructors to reconsider certain accepted theories in connection with so-called ' fireproof ' materials.

" From the fireman's point of view these ' fireproof ' buildings have an element of danger added because of their construction, both in the way of increased risk to the fire brigade and the destruction of property. If such buildings were to remain unoccupied and to be subject to no risk beyond the combustibility of their own non-inflammable construction, then certainly they could with propriety be described as ' fireproof.' But when (as is universally the case) such buildings are stored with goods readily inflammable, the buildings cease to be ' fireproof,'

for the action of the fire plays havoc with that portion of the material which is theoretically 'fireproof.'

"Sufficient attention has not been paid to the bearing these so-called 'fireproof' materials have in relation to the calorific effects of the burning materials stored in the buildings, for, after all, it is the contents rather than the structure which in a large majority of cases commence to burn, and which will continue to burn, no matter in what kind of building they are stored. Sufficient attention has also not been paid to the effect of water applied to building materials after they have been subjected to extreme heat.

"How do these 'fireproof' materials assist the salvage of either the buildings or their contents? Do they assist entrance with safety to those combating the fire?

"On each of these points I shall endeavor to prove a negative from my own personal experience, which I feel confident is not singular, but is common to the fire profession."

The author proceeded to condemn the use of stone and iron as fireproof materials, and advocated the use of wooden floors, posts, etc., well covered with plaster on wire lath. Particular emphasis was laid upon the fire resisting virtues of heavy wooden stairways. He talked of exposed metal work, and did not discuss the American systems of concrete steel construction. He strongly advocated the use of slow burning wooden construction. No one would question the soundness of his contention, if unprotected iron construction were allowed, but such methods are out of date in this country and would not be allowed in any first-class city in fire resisting construction. It is surprising to learn that such construction is allowed in cities like Edinburgh and London.

Conclusion.

"The opinions I have expressed in this paper are facts well known to the fire service and recognized by some architects, and are worthy of the most serious attention by the building profession generally. There are many points in building construction which are continually presenting themselves to the fireman, but which the architect rarely sees and has therefore

no opportunity of studying, and these points when advocated, being so foreign to accepted ideas, are naturally very adversely received and criticised by the building profession.

" As a case in point, some time ago whilst in conversation with the authorities responsible for an important historical building, I suggested that certain additional precautions should be taken from a fire prevention point of view, and as a precautionary measure in dealing with a possible outbreak. I knew there were very bad risks, especially in the roof, which I pointed out, but was told that the building was perfectly safe, the roof was not an old one, it had been renewed not more than forty years ago, and that iron doors had been put in to divide the different sections of the building. Now every fireman knows that a long continuous roof which exposes a forest of unprotected and rough edged and dried timber is a very dangerous risk; also that iron doors have long proved a failure as a protection against the spread of fire, and that they are inferior to a solid heavy wooden door which remains in position long after the iron door has buckled out of its frame and ceased to fill up the opening.

" Whether or not I have made my meaning clear or overstated my views I think you will at least agree that the subject is one of more than passing importance, and that exchange of views and experience is most desirable. To prevent possible misunderstanding I desire to say in conclusion that while advocating the more general employment of timber in buildings, I do not include in this category the light pine and deal stairways, thin wooden doors and matchboard lining partitions, but the employment of substantial timber well protected where possible and, of course, the avoidance of all exposed edges.

" The conclusion I have arrived at after much observation during a long experience of fires in London and Edinburgh is that ' fire-proof ' construction as generally understood is a source of danger; that wherever possible good timber flooring, supports and stairways should be employed together with brick partitions; a liberal application of plaster and an avoidance of air spaces would result in a lesser destruction of buildings by fire, insure easier manipulation of fire-appliances and a more

effective use of the same, and result in a greater salvage of property during the progress of fires.

"In a word, I advocate the study and use of fire-retarding, rather than non-combustible, materials as the direction in which safety and fire protection may more certainly be found; whilst where the more modern forms of planning necessitate provision for big spans and very heavy loads, the systems of construction now erroneously termed 'fire-proof' must be so protected as to become fire-resisting."

Discussion.

Mr. G. de Marie (President of the Luxembourg Fire Brigades Federation)—On one passage in Mr. Pordage's excellent paper, in which he says: "Where a staircase must necessarily run through a building, stone or concrete should be avoided in its construction, but good solid wood * * * is the most reliable under all circumstances," I cannot altogether assent to that. I prefer, as the best stairs, stairs of brick; I think those are certainly better than wooden stairs.

Mr. Pordage—I quite agree. I certainly prefer brick. In this passage of my paper I was merely comparing wood and stone for stairs.

Mr. A. Darbyshire, F.S.A. (Vice-President of the Royal Institution of British Architects)—On the question of staircases, I have followed carefully the arguments of Mr. Pordage, and I hold with him to a certain extent; that is to say, for domestic houses and private buildings I think his idea of good brick stairs is excellent; but in all public buildings—theatres, large stores, cotton mills, where large numbers of people are employed—I prefer the use of concrete in a neweled space; that is to say, that on no account should there be any opening into the staircase except as regards that very part from which people have to escape. I know that to-morrow we have a discussion fixed as to fire prevention with particular regard to theatre safety, and I will not now trench upon that; but I just wanted to say that, with regard at any rate to public buildings, I cannot follow the arguments that Mr. Pordage has advanced as to the adoption of wood for staircases.

Mr. E. G. RIVERS, M.Inst.C.E. (Official Delegate of His Majesty's Office of Works)—In connection with the paper read by Mr. Pordage, I desire to offer a few practical observations upon the question of fire resisting construction. I will not say "fireproof," because I do not think that at present we have reached that stage. I start with the assumption that buildings must always form three classes: the domestic or residential, the public building and the warehouse or office building. Obviously, therefore, there must be distinct methods of dealing with these three classes in a fire resisting sense. It would be unreasonable to apply the same standard of construction to the domestic building as you would to the public building, nor is there necessity for such a course; it would be unnecessarily expensive in the former case; but very much can be done as regards domestic buildings in rendering wood construction less inflammable and in providing better means of escape for the occupants in case of emergency. Wood joists and floor boards can be indurated with one of the many solutions now on the market for rendering wood less inflammable. Roofs, again, can be formed with fire resisting material such as silicate cotton under the outer covering. Ceilings can be plastered upon network carrying silicate cotton or other fire resisting material, and this without adding any great expense in the construction of a domestic building. Now, starting with the assumption that the contents of a building must be more or less inflammable, the object of the designer should be to adopt such a system of construction as to allow of the contents of any one room being destroyed without risk of the fire damaging the fabric or extending to other parts. In constructing a modern steamship on the water-tight compartment system, the object in view is rather similar; it is, to confine any damage to the particular compartment affected. No doubt, if it were possible to fit every room in a building with iron doors and shutters which could be closed from the exterior by hydraulic power—always supposing there was no one resident on the premises—I think a fire occurring on any part of the premises would be localized and extinguished, owing to the fact the amount of oxygen necessary to support combustion

Advocates Use of Fire resisting Wood.

is not forthcoming. Unfortunately, it is scarcely possible to provide such a system because its cost precludes its application to the average public building. Oxygen necessary to support combustion is supplied by breaking open windows to allow the play of jets from fire-hose, supplemented by doors being left open, and not afterwards accessible for closing. There can be no doubt that, in the construction of a fire resisting building, the floors are of primary importance. The introduction of iron, in the form of girders and columns, supporting brick arch or concrete floors, led to developments in construction which from every point of view, except from the point of view of fire resistance, appears to have satisfied architects and engineers over a long period of years. Only now and then, as the result of a more than usually serious conflagration, was attention directed to the fact that iron girders deflected, allowing floors to collapse with them, and red-hot cast-iron columns flew to pieces when water came into contact with them. Gradually it became evident that some system of protected ironwork construction was desirable, and numerous applications of this idea have been evolved with more or less success. Comparatively few constructions have, however, approached the *crux* of the whole matter, which may be summed up as follows: The best weight carrying and fire resisting floor construction is that in which the steel members, while reinforcing the concrete on the embedded system, are themselves kept to such a sectional area as to avoid disruption of the concrete under the extremes of expansion and contraction. In this sense it becomes evident that in adopting built girders, rolled joists, or cast-iron columns in connection with floor construction, we incur a risk of failure in case of fire, unless this construction is supplemented by a costly system of protection, which may even then be of doubtful utility. These facts seem to be better understood on the Continent, and I would briefly refer to some special forms of construction which have been in use for many years with marked success. One of the oldest is, I think, that known as the Cottançin system. I have now at my office a slab of reinforced concrete exemplifying this system. This slab has been subjected to the some-

Doubts Value of Covered Metal Construction.

what unusual test of being placed in a furnace and brought to white heat for a period of twenty minutes, and then suddenly quenched in cold water; yet it can be seen that its strength is not in any way impaired, and, indeed, it is almost undamaged. The embedded steel girdwork is 3-16 in. diameter, and one great advantage of the system as compared with any form of even mesh network is that being laid *in situ* the construction can be further reinforced along the lines of greatest stress before the concrete is filled in. A very important factor in the case of concretes used for fire resisting purposes is the character of the aggregate. Many concretes, though admirable for supporting a load under ordinary conditions, are absolute failures from a fire resisting point of view. If a rotten aggregate, or an aggregate which calcines under heat, is used, failure must be looked for. A typical aggregate is one which has already been vitrified, such as crushed furnace slag. The aggregate in the sample of Cottançin concrete to which I have referred is formed of very small pebbles, such as are met with in fine-washed Thames ballast. This aggregate very perfectly performs the functions necessary in concrete of a maximum strength, namely, as a nucleus around which the process of crystallization in the setting of the cement goes on. In the Cottançin system the girders supporting the double slab floor construction are made on the site. Two flat iron bars form the top and bottom flanges, and the 3-16 in. rod wound over these, forms the web. The whole is embedded in concrete, while laid upon a flat centering. When finished, these girders have a section nearly resembling the old form of cast-iron girder; they are not laid parallel in supporting floors, but they intersect diagonally in a system of triangulation. Other ingenious systems have been devised by M. Hennebique and M. Bonna; and I would ask this Congress to note particularly that, in all these systems, the modulus of elasticity which iron bears to concrete has been carefully considered, and all are very economical in construction. Next in order of importance in a fire resisting building is the roof. With regard to roofs, if of curved or mansard form, they can be constructed in reinforced brickwork, requiring no internal trusses or ties. If

Kind of Concrete.

Cottançin System.

flat, the construction should be reinforced concrete, similar to the floors. Balconies should be constructed, on all floors, above the ground; these could be carried on continuations of the main girdering as cantilevers. Staircases formed of reinforced concrete, with rock-asphalt finished on the treads, would, in my opinion, be preferable to stone stairs. In conclusion, sir, I wish to express my appreciation of the value of the testing work which is being carried out by the British Fire Prevention Committee; that is a matter of extreme interest; but there is just one test which they do not appear to have conducted yet, namely, a test of the fire resisting properties of a floor which is attacked on both sides. I hope that they will deal with that when opportunity offers.

Concrete Stairways Advocated.

Mr. HOUSTON DUNN (Official Delegate of the Engineers' Club of Philadelphia)—I propose, in going through this paper, to note some of the points made by Mr. Pordage, and to bring in the application of the practice of the United States upon those points. On the first page Mr. Pordage suggests the question: "How do these 'fireproof' materials assist the salvage of either the buildings or their contents?" In the United States we make our fireproof buildings with little or no floor openings. In our large centres our building laws require that there shall be no openings in floors, and that is their protection, the stairways being outside. It will readily be seen, therefore, that the salvage, especially from water damage, will be large where the floor is tight, and the water does not go from floor to floor. It seems to me that in arguing, as I understand Mr. Pordage to argue, for timber construction—or what in America we call mill construction, in contradistinction to fireproof construction—he has not brought out the point which our engineers are taking up from time to time, that a building of wooden construction carries within itself a method of its own destruction. We admit that if, as the result of long spans of pile or concrete, and the girders or beams being insufficient to keep them from being deflected, those floors should come down, the same condition exists, in a measure, in a fireproof building; but we say that by reason of the wood in the non-fireproof building it will burn that much longer. Under

Floor Openings.

Floor Construction.

the heading "Floors and Ceilings," Mr. Pordage says: "If wood posts or columns are wire lathed, and coated with good plaster, and treated in a manner similar to that often adopted with iron columns, they would come out practically unscathed." I should like to say that that is, practically, done in America, but unfortunately the custom has gradually grown up of leaving out the wire lath, and in buildings of ordinary construction it is plastered directly upon the wooden beams. The timber is given out and run through the mill so rapidly that it has not had sufficient time to season; it is taken from the mill or the lumber yard, where it has only rested a short time, directly to the building, and it is there allowed to remain in the streets subjected to the weather, and when it is put into place it is immediately covered with plaster. I have seen pieces of timber as large as 10 by 12 uncovered in buildings which were being torn down, where dry rot had set in to such an extent that a handful of material could be taken right out, just like a sponge. In our big buildings our floors that are of wooden construction are bound to have, not joists, but wooden girders and beams of a given strength. With regard to Mr. Pordage's criticisms of concrete flooring, he seems to have come to pretty much the conclusion that we in America have; our trouble with the concrete arch has been that the span of the arch has been too great; we have no trouble with them up to 8 feet, but past that they have failed. In relation to stairs, I may say that it is necessary, in all municipalities of the first class in the United States, to build our stairways outside of the building completely; there is no direct access into the stairway; you have to pass out from the building on to the escape, and then back into the stairway, which is built of wood held in brick walls. These remarks cover the main features I want to bring out except in regard to one matter. I think Mr. Pordage has called attention to the fact that iron, because it will twist, is worse than wood; yet he advocates that a cast-iron roof should be used; it seems to me that he is a little inconsistent in that.

Dy due to Plaster on Wood.

Outside Stairways.

Mr. J. H. Dyer (Vice-President of the National Fire Brigades Union)—I have been very much interested, from a fireman's point of view, and also from some little knowledge

of buildings, in the remarks Mr. Pordage has made. There are one or two things that are often noticeable, both in seeing buildings after a fire and during the progress of a fire, with regard to the partitions inside. Mr. Pordage advocates brick right through; we must all agree with him in that, but in some cases where that is impossible it is necessary to have lath and plaster or something like that. There are several of these lighter forms of partitions made now. If it is positively necessary to have a wooden partition, I have found that if you have a floor well pugged, and the plastering is well carried down and allowed to dry properly before the skirting is fixed, that is a most effectual means of stopping fire. Then with regard to these parapet walls, from an architectural point of view we cannot say that they are very handsome if they are carried three or four feet above the floors; and again, if you get too many parapet walls in expensive structures it is necessary to have lead and other things, entailing great expense. If these walls are only carried up to the underside of the slate or tile that is a wonderful protection as regards fire. I have been very interested in what we have seen to-day in the other room with regard to the practice in America, especially in the matter of fire escapes. I have seen these great buildings being carried up on steel frames. But I would just like to say this: I remember talking to Chief Croker and asking him, "What about the people getting out?" He said, "All those above the seventh or eighth story will have to burn!"

Chief Croker's Idea of Safty of High Buildings.

Mr. PORDAGE—I need not detain you long in replying to the remarks that have been made. I quite agree with the first speaker as to the advantages of a brick staircase; provided there is no opening in the wall for the fire to get through, such a stairway is undoubtedly very preferable. With regard to Mr. Rivers' remarks, I think they are generally in accord with my own views as expressed in the paper. The observations of Mr. Houston Dunn, after all, I think, tend to show that sound wood—I am not talking of green wood, but sound and solid beams and joists—so far from bringing about the destruction of a building under fire, very often preserve it in its originality. You will see many a building with all the walls standing after

the building has been gutted, the walls supported by wooden joists and beams and uprights; whereas in similar circumstances, with concrete and iron, more often the walls have been brought down. Mr. Dunn alluded to my suggestion with regard to plastering on wire; he says that that has been tried in America, but they found the plastering was put on without the wire; I do not see that that is any answer to my suggestion. The objection I have to all kinds of steel and iron and concrete erections is that it is the heavy weight of the material of the structure that tends to wreck the building more than the burning of the structure by fire. I certainly do advocate iron trussed roofs. It may appear, perhaps, on the surface, inconsistent with other parts of my paper; but the roof of any building, unless it is well protected by a very expensive process, is a very dangerous part of the building. We all know that the general structure of an exposed roof is such as to lend itself to the destruction of that roof; also it is in an exposed situation in regard to liability to catch light through chimney fires. If the roof is built upon iron trussing, there is no inflammable material about the roof. Usually the collapse of the roof is brought about by the buckling of the girders, and the consequent falling out of position of those girders, brought about by the weight they have to carry. The iron trussed roof has no weight to carry, and, therefore, if the roof is non-combustible, it does not get alight, and, having no weight to carry, it does not buckle. With regard to Mr. Dyer's remarks, I quite agree with him that the filling in of the air spaces with pugging or some other deafening is a good method of preventing the spread of fire from one part of a building to another.

Weight of Concrete and Steel Dangerous.

SECTION I.

MODERN WAREHOUSE CONSTRUCTION IN HAMBURG.

By Chief Officer Westphalen, Fire Brigade, Hamburg.

(Translated from the German.)

Extract.

The speaker explained that there were two classes of storage houses in Hamburg—Wharf Sheds, or Temporary Warehouses, and Warehouses proper.

Wharf Sheds.

The former are located on the water front, covering an area of over 400,000 square meters, and are largely under Government control.

The handling of cargo is done by traveling cranes. There are 272 steam, 215 electric, 17 hydraulic and 137 small hand-operated cranes.

Merchandise in general is almost continually in motion, making it necessary to have the goods on the ground level, so the buildings are of one-story construction. In general, these buildings are 200 meters long, 50 meters deep; no partitions in the interior; they are usually open or exposed on the water side of the building and are not fireproof. The rear or opposite long side is boarded up, the two end walls of masonry. The roof, being of gable type, overhangs the end walls.

The houses are built 30 meters apart. In some instances two buildings connect; that is, one end wall stands between. Fireproof doors connecting the buildings. The floor space is about 10,000 square meters. Each section or separate building has its own fire risk. The inner supports as well as the

general construction of the roof, which is covered with pasteboard, is of wood.

A construction that would stand a fierce fire cannot be used for such purposes. The construction of the roof would suffer in any event. Besides, a light wood construction is much easier to remove and renew than an iron one. Therefore, it is considered more practical and economical to have wood construction, for in case of fire the delay in traffic is short and the loss in time or money is not great.

Warehouses.

Warehouses are of two or more stories in height, on account of the valuable ground space on which they stand.

The warehouses are built 16 meters wide, 22 meters deep; they contain floor space of about 325 square meters after deducting staircases, etc. The outer walls are of solid masonry, roof fireproof, gable walls are carried 1½ meters above it. The inner construction is of iron. The columns are covered with fireproof material. Girders are also covered. The covering is called "Koenen system." Flooring of wood. There is a pitch to the floors so as to let the water run off that is used to quench a fire. The staircases are two in number for each building, the front one used for general purposes, the rear one for safety. In the cellar they have a fireproof entrance for the rear staircase. The rear staircase goes up to the roof. This staircase is used for the two buildings, each building being connected by iron balconies. On the roof there are iron ladders which can be used for climbing over the gables. These staircases make it possible for the Fire Department to fight the fire from two sides.

Often it is found that some of these buildings originally intended for storage are used as factories in one or more of the lofts.

The law requires that such lofts or parts of loft must have fireproof partitions between factory and storage rooms. All openings through which belting for machinery runs must be fireproof covered or protected.

In spite of the modern warehouse as here given, the Fire Department of Hamburg have had a difficult problem to solve before they could fight the fire successfully. The engineers

have always objected to covering the ironwork with fireproofing material, as they considered their ironwork ornamental. Their main objection to the covering material, aside from the objection above given, was that the ironwork would suffer from corrosion.

The Fire Department, through the insurance companies, fought this question of exposed ironwork. Oak was used in the place of iron where possible, but in general the large cross-sections required to carry the loads, also the cost, made it impossible, and so iron was finally adopted.

Notwithstanding the improved methods of construction, etc., the insurance rates have not been reduced.

SECTION I.

FIRE PREVENTIVE SECTIONS OF THE LONDON BUILDING ACT.

By Bernard Dicksee, *District Surveyor, London.*

Building legislation is a highly intricate and technical subject, and to be well understood demands very close and careful study; it is therefore hardly a matter for astonishment, though much to be regretted, that the decisions given in the courts are so often not in accordance with the obvious intention of the enactment. These decisions do not facilitate the work of any one whose duty it is to enforce or to build under the Act.

The existing law in London dealing with the construction of buildings is comprised in five Acts: The London Building Act, 1894, and the London Building Act, 1894 (Amendment) Act, 1898, dealing with building generally. The Metropolis Management and Building Acts Amendment Act, 1878, sections 11–13, and the Metropolitan Board of Works (Various Powers) Act, 1882, sections 45 and 48, dealing with theatres and like buildings. The Factory and Workshop Act, 1901, dealing with exits from factories and workshops.

My paper to-day will deal only with the fire sections of these Acts, their effect upon the construction of buildings, and suggestions for the amendment of the law where such has been found by experience to be necessary or desirable.

The administration of the law in London differs materially from the administration of the law in the remainder of the kingdom, greatly to the advantage of London. As this is much misunderstood by the lay mind in London, and probably unknown to many in the provinces, it will, I think, be well to preface this paper with a short statement of the law in London on this point.

Duties and Qualifications of District Surveyors.

S. 140

The constructive portions of the London Building Act are administered by district surveyors, who are qualified architects that have passed a special examination held by the Royal Institute of British Architects; no one may be appointed a district surveyor unless he hold the certificate that he has passed this examination. The district surveyor is not the officer of the County Council nor of any other corporate body, but is an independent statutory officer; this has now been finally decided by the High Court in the case of City of Westminster *v.* Watson and others (1902, XVIII. Times L. R., p. 621). To the

S. 138

district surveyor is entrusted the duty of supervision of "every building or structure, and every work done in, to, or upon any building or structure, and all matters relating to the width and direction of streets, the general line of buildings in streets, the provision of open spaces about buildings and the height of buildings." In some cases he has discretionary power, as in the case of public buildings, breastsummers and their supports, and open sheds.

S. 145

Two days before any building structure or work is commenced notice must be given to the district surveyor, giving

S. 150

full particulars. Should such notice disclose work that would be contrary to the Act the district surveyor is required to serve a notice of objection, against which the owner may appeal to a petty sessional court.

S. 151

Where, during the progress of any work, anything is done contrary to the Act, either by omission or commission, the district surveyor is empowered to serve notice of irregularity

S. 153

on the builder, requiring him to amend. Should the builder neglect to comply with the notice the district surveyor will proceed against him at a petty sessional court, when the magistrate will, if satisfied that the notice of the district surveyor is in accordance with the Act, make an order on the builder to comply; for neglect to do this the builder will then become liable to a penalty of £20 a day. There are also provisions for the service of notice on the builder and the owner after the work is completed, but not in accordance with the Act.

London is divided into districts (now 63), to each of which there is a duly appointed district surveyor, who is paid by

statutory fees upon each work done, but receives no salary of any description.

Duties of County Council.

The duties of the London County Council under the Act are mostly discretionary. All new streets have to be approved by them before construction. No building may be erected beyond the general line of buildings or within the prescribed distance of the centre of the road without the consent of the Council. The Council has also power to sanction the construction of iron buildings and buildings to which the rules of the Act are inapplicable, to allow certain deviations in the height of buildings, the open space about buildings, projections from and the alteration of buildings, and sundry other discretionary matters. When consent has been given by the Council in any of these cases, a copy of the consent, together with the drawings, is sent by the Council to the district surveyor, and it is his duty to see that the conditions of the consent are duly observed, in the same manner as though the building were being erected under the provisions of the Act itself. But the Council is the authority to enforce the removal of dangerous structures, and to grant certificates as to the safety of exits from high buildings.

It will thus be seen that, whereas in the provinces application for the approval of plans must be made to the local authority before a building can be commenced, and the building must subsequently be erected under the supervision of the local authority acting by their officers; in London there is no delay, the building can be begun two days after notice has been given to the district surveyor, who is the authority to enforce the execution of the Act. S. 146

Application of Act to Theatres.

When, however, we come to the Acts of 1878 and 1882, dealing with theatres, and the Factory Act of 1901, proceedings are different; the execution of the constructional sections being vested in the County Council. Of this I shall have more to say later.

The fire sections of the London Building Act may be grouped into four groups:

1. The separation of buildings from each other to prevent the spread of fire from building to building.

2. The sub-division of a building to confine the fire to one portion of the building.

3. Fire-resisting construction to prevent as far as possible the comencement of fire.

4. Provisions for exit in case of fire.

In some cases the same section would come within more than one of these groups, but I think the most convenient way of dealing with the subject will be in this form.

Separation of Buildings.

Party Walls.

Buildings may be separated from each other, either directly by party walls and party floors, or indirectly by their external walls and roofs.

Sch. I.

The first schedule provides that every building shall be enclosed by walls of brick, stone or other hard and incombustible substances, and sets out the method of construction and the thickness; this latter is only of importance for our present subject in so far as that it is necessary that a wall should be stable to prevent the spread of fire; it must not collapse during a fire; on this score there is nothing to fear from the thicknesses in the schedule.

These enclosure walls will include party walls and external walls, which the London law requires to be of the same thickness.

S. 59

The use of the party wall in preventing the spread of fire has been established on many occasions, but in no case more so than in the Cripplegate fire, where the fire, checked by the party walls, spread by crossing and recrossing the street.

The party wall is required to be carried up above the roof of the highest adjoining building, 3 feet in the case of a warehouse exceeding 30 feet in height, and 15 inches in the case of other buildings; it must also be carried up 1 foot higher and wider than any dormer, etc., on an adjoining roof, and as high as any portion of the roof within 4 feet of the wall. This figure is probably enough, except that in the case of warehouse buildings less than 30 feet high the party wall should be carried up 3 feet above the roof; it should be remembered that it is the class of building more than the height that makes the risk, and

the 3 feet parapet is required as a screen for firemen to work behind. London, however, is well in advance on this point, as the Montreal Building By-law of 1902 only requires 12 inches in any case, and the Glasgow Building Regulations Act, 1900, requires 2 feet for warehouses and 12 inches for other buildings.

Openings.

The efficiency of a party wall to prevent the spread of fire depends upon its integrity; it is therefore of the utmost importance that openings in it should only be very sparingly allowed and under close supervision. Buildings may only be united when wholly in the same occupation, and when looked upon as one building will be entirely in accordance with the Act. If the buildings, taken together, exceed 250,000 cubic feet in contents the openings must be closed with iron doors ¼ inch thick in the panel, one on each side of the wall, fitting into proper frames, and no woodwork of any kind is allowed; the openings must not exceed 7 feet in width by 8 feet in height unless the doors be at least 24 inches apart, in which case the opening may be 9 feet 6 inches high. In some cases the small width allowed for this opening presses rather hardly, as it will not allow of the passage of a van, a not infrequent requirement of the tenant. A great defect in this section is the lack of enactment as to fastenings; a pair of iron doors are of little use unless securely fastened at each edge; there should be at least three fastenings (top, middle and bottom) required on the lock style, and a heel bolt in the centre of the hanging style in addition to the pivots. This deficiency is partly removed in the case of sliding doors, which must be "properly constructed"; this gives the district surveyor more control.

S. 77

Iron Doors.

It is open to question whether the iron party wall doors required by the Act are the best doors for the purpose; power should be given to the County Council, on the advice of the District Surveyor's Association, to make by-laws to allow the use of doors constructed of other material.

When buildings that have been united cease to be in one occupation, notice must at once be given to the district surveyor, and the openings must be at once bricked up. There are, however, doubtless many cases where no such notice is

given, and the omission is difficult to detect. It should therefore be enacted that the owner or occupier of any building connected with an adjoining building by an opening in the party wall, should make application to the district surveyor for a certificate as to each opening; such certificate should state that the opening is in accordance with the Act, and should be renewable every two years. If at any time the district surveyor discovered that the opening was in any way irregular, or that the buildings were no longer in the same occupation, or that an opening had been surreptitiously made he should have power to refuse a certificate, and to cause the opening to be bricked up. The district surveyor would thus have a register of all permitted openings and could therefore keep better control over them.

But perhaps the greatest difficulty as to party wall openings a district surveyor has to meet, is the case where one opening has been made surreptitiously uniting two buildings; this may be and probably is quite irregular; but no notice having been given and the work having been done as secretly as possible, the existence of the opening never comes to the knowledge of the district surveyor, until such time, perhaps years afterwards, that it is desired to make another opening, of which notice is given. The second opening does not unite the buildings, for they were united when the first opening was illegally made; the district surveyor is therefore powerless to prevent the new opening, or, in many cases, to cause the old opening to be closed. Thus the owner is allowed to profit by his illegal action. This point formed the subject of a decision of the High Court in the case of "Woodthorpe *v.* Spence" (63 J. P. 246), when the district surveyor failed for the reason just stated. The remedy for this would be the insertion of a clause making the formation of any subsequent opening a uniting of the buildings in law, though not actually in fact, and declaring that such subsequent opening shall be subject to the same rules as though it were a first opening. The system of certificates above suggested would also greatly assist matters.

S 74 (1) Section 74, sub-section 1, requires buildings to be separated by party or external walls or "other proper party structures";

there is a definition in the Act of a party structure but none of a "proper party structure." Clearly it is intended that the separation shall be of fire-resisting materials, equal to a brick wall. If the words "party arch or party floor" were substituted for "proper party structure" the law would be clear, as section 71 deals with the construction of party arches and floors, requiring brick, stone or other incombustible materials, of the thickness of 8½ inches; the floors to be constructed in such manner as may be approved by the district surveyor. S. 71

Dangers from Windows overlooking Adjoining Roofs.

The question whether openings, such as windows, are or are not permissible in the upper portion of a party wall overlooking the roof of the lower building when the two buildings are of different heights, has caused much discussion and difference of opinion; but there can be no two opinions as to the danger of such openings from the facility they afford for the spread of fire, particularly from the lower to the higher building. This danger was fully proved by the fire that took place in December, 1898, in New York, when almost the whole of the upper stories of the Home Life Insurance building, overlooking the adjoining lower building, were burnt out by a fire that was communicated from the lower building through the windows overlooking the roof.

Home Life Ins. Building Fire, N. Y. City.

Should any dormer or other similar erection of combustible material be placed upon any roof within 4 feet of the party wall, the Act requires the party wall to be carried up 1 foot higher and wider on each side than the erection; but when the window is advanced to and fixed in the party wall, thereby increasing the danger, it is the contention of some persons that such an arrangement is allowed by the Act. S. 59 (2)

This view appears to be based on the decision of the Chancery Court in the case of Weston *v.* Arnold, (22 W.R. 284), but it must be remembered that this was a case not under London law, but the Bristol Improvement Acts, 1840 and 1847; the requirements as to party walls being different under those Acts, which do not require the party parapet; moreover, it was not an action to enforce observance of the building law, but an action for injunction to restrain the defendant from blocking up a window opening that was being reconstructed in its old

position in a re-erected party wall. The judges naturally supported the owner of the right of light, and held that unless there is something to the contrary in the Act a wall might be in part of its length and part of its height a party wall and an external wall for the remainder, but they did not decide that such must be the case under all circumstances. Indeed, they cited instances to the contrary.

A case more in point is that of Williams *v.* Bull (only reported in the *Times,* February 15, 1890), decided under the repealed Metropolitan Building Act, 1855, where W. had raised the party wall between his building and B.'s under the powers granted him under that Act; but when B. subsequently sought to again raise it he objected, unless B. paid him for a share in the first raised portion, which he claimed to his own external wall; it was, however, decided to be a party wall, and that B. was entitled to use it without payment.

There is yet another decision, that of Drury *v.* Army & Navy Stores (60 J.P. 421), bearing on window openings in party walls, but that case deals not with party walls proper, but only with quasi party walls, the expression party wall being used merely as a convenient phrase for subdividing walls within the same building, used to divide a warehouse into fire risks. In this case the windows were held to be allowable, and I am afraid that this decision will encourage the view that they would be allowable in party walls dividing buildings in different occupations, but I do not think that this view is justified by the sections of the Act. The actual point has never been before the High Court.

S. 54 (3) As openings are prohibited in party walls except in accordance with the provisions of the Act as contained in section 77 above cited, the whole question will depend upon the point as to whether the upper portion of the wall is a party wall or an external wall; the only London case dealing with party walls proper (Williams *v.* Bull) is in favor of the former alternative. Section 58 limits the party wall to such portion of its length as it is used by buildings on each side, and therefore, by implication, does not so limit the height. Section 101 allows the reconstruction of an existing ancient light in a party wall; it

S. 58

would therefore appear that the upper portion is a party wall, as that would be the only part of the wall in which an ancient light could exist. Section 59 requires the party wall to be carried up 15 inches or 3 feet, as the case may be, above the roof of the highest (not the lowest) building adjoining. Section 88 (5) confers on the building owner the right to raise a party wall, not to erect an external wall on the party wall. On the other hand the only argument in favor of the external wall theory is the Bristol case, which is, in my opinion, not a ruling case for London law, as the London Building Act does, in fact, make the enactments that were held in the Bristol case to be necessary to make the wall a party wall.

The question, however, is sufficiently open to doubt to make it desirable to amend the Act by inserting a section declaring the wall to be a party wall for the full height of the highest building, and prohibiting openings except in accordance with the rules of the act as to openings in party walls.

Roof Covering.

The indirect separation of building has not received in the Act the consideration it deserves. Beyond the requirement that buildings shall be enclosed by brick or stone walls, that roofs shall be covered with slates, tiles, metal, or other incombustible materials (section 61), the prohibition of woodwork in the external face of external walls (section 55), the requirement of a parapet whenever any part of the gutter is of combustible material (section 57), and the limit of the area of openings in external walls above the ground story to one-half the area of the wall above that story, little or no attention has been given to the subject. On the contrary, one section, though not strictly describable as a fire section, has decidedly an opposite effect.

S. 61
S. 55
S. 57

Allowable Height of Buildings.

The proviso of section 13 (5) enacts that no dwelling inhabited by the working classes shall be erected within the prescribed distance of the centre of the road to a greater height than the distance between the front wall and the opposite side of the street. Now the height of the building is defined as the height of the front wall or to the base of the gable, if any, and does not include the two stories in the roof permitted by section 62 (1), the surface of which roof may be inclined at an angle of 75 degrees to the horizon.

S. 13 (5)
S. 5 (21)
S. 62 (1)
S. 61 (4)

Suppose then the case of a street or alley 12 feet wide (and there are many such), the front wall may only be 12 feet high, but above that there may be two stories in the roof with an almost vertical front enclosed by a stud partition covered with slates. Surely this is an encouragement to the spread of fire. Should the ground story be a shop there would be no brickwork at all in the front. The enclosure of the front of such houses with brickwork should not be discouraged. The defect might be amended by limiting the height above the road of the ceiling of the topmost story to 20 feet more than the distance of the front wall from the opposite side of the street or by keeping the whole building within an angle of 45 degrees of the horizon, taken from a level of 16 feet above the street level at the opposite side of the street.

Dangers from Crowding of Warehouses.

The crowding together of warehouse buildings on narrow streets and contracted light wells in the rear is a great source of danger; the four great fires in the City of London—at Wood street, St. Mary Axe, Cripplegate and Barbican—are to be attributed to this crowding. The source of weakness is clearly the proximity of window openings and roofs to each other. This question is nowhere dealt with in the London Building Act, though it is somewhat imperfectly in the Montreal Building By-law of 1901.

It is suggested that in warehouses all roofs should be fire-resisting, that all windows overlooking a street of the width of 20 feet or less, or a light well or area of a width of 20 feet or less, into which the windows of other premises look, should be fitted with metal frames glazed with wired glass, or be fitted with shutters of hard wood, iron or other fire resisting materials capable of being closed from the inside; and that all external walls abutting on such streets, wells or areas should be carried up as parapets 3 feet above the roof.

The Subdivision of Buildings.

S. 75

Limit of Cubical Contents.

S. 76

Warehouse buildings must be subdivided by party walls so that no compartment exceeds 250,000 cubic feet in contents, but the County Council have in certain cases the power to allow an extension of this figure to 450,000 cubic feet. Although the

more recent Glasgow Act of 1900 allows a limit of 350,000, the London limit of 250,000 cubic feet is excessive, unless all the floors of the building be fire resisting. The fire insurance companies encourage a 100,000 cubic feet limit by charging an extra premium on larger buildings, and I am inclined to the view that that should be the limit—the extreme limit—where fire-resisting floors are not employed, but I should prefer to see all floors in warehouses over 10 squares in area made fire resisting.

The question of the subdivision by fire resisting floors, instead of walls, came before the High Court under the corresponding section of the 1855 Act in the case of Holland and Hannen *v.* Wallen (70 L.T. 88), when it was decided that a subdivision by floors did not comply with the Act.

Buildings exceeding 10 squares in area used in part for trade or manufacture and in part for dwelling are required to be separated by fire resisting walls and floors, so as to protect the person in the dwellings in case of an outbreak of fire in the trade portion. This section was inserted in consequence of several serious fires in shop premises, resulting in loss of life. It has, however, been very unfortunately drafted, and has afforded much scope for the ingenuity of judges, enabling them to place most original constructions upon it. No real difficulty was found in the working of this section until the decision of the High Court created one.

S. 74'(2) Fire Resisting Floors in Large Buildings.

The decision of the Court in the case of Canitt *v.* Godson (1899 2 Q.B. 193) removed public houses from the operation of the section, and although the plaintiff succeeded on the appeal, the decision of the Court of Appeals in the case of Dicksee *v.* Hoskins (65 J.P. 612) practically did the same for beer houses. In consequence of these two decisions the present effect of the section is so uncertain that its immediate reconstruction so as to carry out its original intention is of the utmost importance.

Buildings exceeding 25 squares in area containing separate tenements used as dwellings or offices, are required to have the floors constructed of fire resisting materials.

S. 74 (3)

The corresponding section of the Act of 1855 required the

Fire Resisting Floors in Tenements.

rooms or tenements to be separated by walls and floors of fire resisting materials; this was found to be impracticable in the case of office buildings, on account of the nature of the tenancies; rooms let together to one tenant are frequently subsequently let separately to a number of tenants, but the mistake was made of remodeling the section in such a way that the fire resisting partitions between different dwellings have been lost. The section should be redrafted, treating office buildings on the lines of the 1894 Act, and dwelling buildings on the line of the 1855 Act.

The limit of the size of the building should not, however, depend upon the area, but upon the height, or the cube, which would include both height and area; the risk from fire is clearly greater in a building of 20 squares in area and five stories in height than in a building of 100 squares in area and one story in height, yet the former does not come within the mischief of the section, but the latter does.

No Law Controlling Size of Tenements.

No limit is at present placed upon the cubical extent of these tenement buildings; this should be amended. It would not be unreasonable to fix the limit at 250,000 cubic feet.

Fire Resisting Construction of Buildings.

As has been before stated, external and party walls must be of incombustible materials.

S. 73.

Projections from the face of the wall are dealt with in section 73; these are required to be of "fireproof" material. Evidently the use of this word is an oversight; it is imported from the Act of 1855. The word "fire resisting" is evidently here intended, as in every other case that word is substituted for the word "fireproof" of the older Act. Wooden eaves and large boards are permitted in the case of detached and semi-detached dwelling-houses, and in terraces where the party wall is corbelled out 4 inches in advance of the woodwork; but in all cases the wall must be built up solid behind such cornice. It is difficult to see why two semi-detached dwelling-houses should, for the purposes of this section, be deemed one building; this proviso was new to the 1894 Act and should be struck out.

Use of Wood Allowed.

Shop fronts are allowed to be of wood and to project from the face of the wall, with some very slight provisions for the interception of the woodwork of one shop from the next. These rules might well be revised; as at present constituted, a one-story corner shop, projecting a considerable distance from the building to which it is attached, may, with the exception of the party wall against the adjoining shop, be constructed entirely of wood, the roof only being covered with metal. S. 3 (3) (4)

Bond timbers and wood plates are prohibited in party walls, but no such regulation exists for external walls; some restriction is surely desirable; the collapse of a wall in case of fire is, in my opinion, often caused by the improper use of timber built into walls. A floor plate or lintel is frequently built into a 9 or 14-inch wall to within 4 inches of the external face of the wall, and this is carried across a small brick pier between two openings, rendering the destruction of the wall certain in case of fire or the decay of the timber. S. 56 (3)

In the Montreal regulations wooden lintels are only permitted when at least 12 inches of brick or stone intervenes between the ends of the two lintels bearing on a pier. If wooden lintels be used they should be required to be arched over with a relieving arch.

Breastsummers, if of wood, must not approach nearer than 4 inches to the centre of the party wall; but there is nothing to prevent them being of wood, however objectionable that may be, nor to prevent them from being entirely supported on wooden story posts. There is not much use in having a fire resisting wall supported on an easily consumed support; the District Surveyor has special power as to the strength of breastsummers and their supports, but not as to the material. S. 56 (1)

In this particular Glasgow is in advance of London; in that city every breastsummer, arch, lintel, column, or other support of a wall must be of fire resisting material, and if of iron must be protected from fire. In Montreal also, wooden lintels or breastsummers are only allowed up to 5 feet span in the inside of an external wall, and up to 6 feet in an internal wall. Glasgow Requirements Superior to London.

The remaining fire sections, relating to internal construc-

tion, are practically limited to the provisions for the construction of chimney flues, hearths and stoves, and pipes for conveying hot water, steam and the products of combustion. These hardly call for special notice, they have been substantially the same for the last 50 years, and have on the whole worked well, though some minor amendments would be advisable. The amendment new to the 1894 Act, requiring the flue from a trade stove, or a furnace or steam boiler, to be surrounded with 9 inches of brickwork, was a much wanted improvement. I have myself known stationery, placed against a party wall in which there was a flue from a fish stove 7 feet away, to be singed.

S. 78.

Power of District Surveyor.

The construction of public buildings is not subject to the ordinary rules of the Act, but they must be constructed in such manner as the district surveyor may approve; the same applies to the conversion into public buildings of buildings originally constructed for a purpose other than public. There is an appeal from the district surveyor's requirements to the Tribunal of Appeal. This regulation may sound very autocratic, but during the nearly 50 years it has been in force it has been found to work well.

Having dealt so far with the requirements of the Act for the construction of buildings, I now propose to refer shortly to some very important omissions from the Act, of subjects that demand legislation.

Perhaps the most important of these is the question of the proper protection of iron and steel from the action of fire. The

S. 164.

Iron and Steel Work not Protected from Fire.

London County Council have, by section 164, the power to make by-laws on this subject, and it is not to the credit of that body that nine years after the passing of the Act no such by-laws have been made. But I venture to think that this is far too important a subject to be dealt with by by-laws; there should be a section in the Act itself requiring the proper protecting of all columns, stanchions, breastsummers and joists. No one that has given any consideration to the subject can have failed to be impressed with the danger of permitting a corner building used for shop purposes to be supported entirely upon cast-iron columns and iron girders without any attempt to pro-

tect the iron. The district surveyor has special powers as to the strengths and support of breastsummers, but none over their protection from fire. Again, when an iron or concrete floor is used, there is nothing in the Act to prevent the lower flanges of the joists being exposed, as they very frequently are, to the action of the fire, and that although it is common knowledge that such neglect will cause the failure of the floor.

Use of Inflammable Materials Allowed.

A very important and almost entirely neglected subject is the internal construction of warehouse buildings. I had the opportunity of inspecting the ruins of Cripplegate after the fire, and was much impressed with the state of affairs that allows warehouse buildings to be constructed almost entirely with inflammable materials. The party walls in many cases remained standing severely alone, the whole of the interiors, consisting of wooden floors, partitions and roofs, the walls and ceilings lined with matchlining, had disappeared. This fire destroyed property to the value of £1,250,000, and yet the district surveyor is powerless to prevent the erection and re-erection of warehouses constructed in this manner.

All warehouse buildings, except perhaps the very smallest, should be constructed with fire resisting floors and roof, including all flats over the rear of lower stories at the bottom of light wells. The staircases should be fire resisting, and enclosed by brick or similar walls carried up to the fire resisting roof, and should be as far as possible shut off from the rest of the building.

Matchlining or Sheathing should be Barred.

Matchlining, particularly in warehouses, should be most severely regulated. It was proposed in the Amendment Bill, now withdrawn for this year, to require that all wooden boarding and paneling should be fixed close to the wall or floor without any intervening space; this would, I think, be impracticable, in addition to being useless; on contact with fire the boarding would warp and curl away from the wall, forming the very cavity it was proposed to prohibit. There can be no doubt that hidden spaces behind boarding or plastering are calculated to induce the spread of fire to an alarming extent; but that danger can, I think, best be met by limiting the risk to the one room; we should then have a real security instead of the false

idea that would be created by the prohibition of space behind the boarding.

In a warehouse or shop premises no matchlining should be allowed to walls or ceilings unless the floors above and below the room, and all the walls of the room in which the matchlining is fixed, are fire resisting, and no space more than is necessary for the necessary battens should be left behind the boarding.

There is not the same risk of fire in dwellings as in warehouses, so that the regulation of boarding need not in dwellings be so severe, and care should be taken in framing any regulation not to prohibit a reasonable amount of wooden paneling in dadoes, window backs, etc.; but matchlined ceilings should be prohibited in dwellings as entirely unnecessary and dangerous.

Regulation of Lath and Plaster Necessary.

The " lath and plaster " partition is another form of construction that requires regulation. I have seen many hundreds of houses constructed with the whole of the internal partitions, floors and roofs of timber, lathed and plastered; such a building could offer no resistance to fire, which, when once behind the plaster face of a partition, would spread immediately to the whole house through the flues provided between the studs. In some of the provincial by-laws this is partially dealt with, by requiring the space between each ceiling and the floor above to be filled in with brickwork at each partition; in other districts the whole partition has to be filled in with brick.

The lath and plaster partition should be discouraged as much as possible by requiring a brick wall or half brick partition wherever support for such is available; this will always be the case on the lowest floor, and very frequently in other situations; though of course half brick partitions are not to be encouraged for more than one story in height. Where stud partitions become necessary, the plastering should be required to be carried down to the floor behind the skirting, and the stories should be bricked off from each other as required by the provincial by-laws.

No Laws to Compel Elevator to be made Fire Resistant.

Lift shafts have nowhere been dealt with in the Act; an attempt to supply this omission was made in the now with-

drawn bill, and the suggested requirements were on the whole satisfactory. The shaft, if inclosed, should be inclosed with fire-resisting material capable of sustaining a severe test, as the shaft, in the case of fire not infrequently becomes a furnace shaft; this inclosure should be carried through the roof or at least covered down with a fire-resisting ceiling. The Montreal regulations of this subject are well worth consideration, and might well be adopted for London.

Necessity for Laws Controlling Steel Construction.

In any amendment of the London law, steel frame buildings should be dealt with, as they undoubtedly will come into use in the near future; they are not prohibited by the present Act, provided the walls be of the schedule thickness, but there are no provisions for stability of construction nor the protection of the steel from the action of fire. These buildings could, in my opinion, be dealt with under section 82, as buildings to which the general provisions of the Act are inappropriate, and be specially licensed by the County Council, but I believe that body does not take the same view.

Wooden Structures.

No notes upon the fire sections of the Act would be complete without reference to the question of wooden structures. These are dealt with in section 84, which requires a license to be obtained from the County Council before any wooden structure may be erected; this power of licensing has been transferred by the London Government Act, 1899, to the Borough Councils created in name by that Act. It is difficult to imagine what can have been the object of the authors of that Act in effecting that transfer, which is certainly one of the most ignorant and meddlesome pieces of legislation ever perpetrated, and has caused nothing but trouble and annoyance to all concerned, without any compensating advantage. The County Council retain the power under section 82 to license iron buildings and structures and any other building or structure to which the general provisions of Part VI. are inapplicable or inappropriate; this section would therefore appear to cover wooden structures, and so render section 84 redundant.

S. 84

S. 82

It is significant that whereas section 82 mentions buildings and structures, section 84 makes no mention of buildings, but refers only to wooden structures: it therefore becomes necessary, now that the licensing under these two sections is in different hands, to draw a hard and fast line between a building and a structure; a building cannot be licensed under section 84 as a wooden structure. This does not seem to be recognized by many of the Borough Councils, who claim to be able to license any erection they please as a wooden structure, and have on several occasions illegally issued such licenses; indeed, the question has become so serious that the County Council have been obliged to take proceedings against a firm for the erection of a wooden building without a license under section 82. In this case the defendant had applied to the County Council for a license for a building covered with corrugated iron, but had been refused, as the building was to contain a furnace and was to be constructed of wooden framing. The defendant thereupon omitted his iron covering, substituting wooden boarding and tarred felt, and applied to the Borough Council for a license for a wooden structure, which was granted; and the building was erected without notice to the district surveyor. On the case coming before a magistrate he decided that it was a building for which the license of the County Council was necessary, and convicted the defendant, and ordered the demolition of the building.

This improper licensing, besides being a great annoyance to the person who is called upon to remove the irregular building, is of great danger from the fire point of view. The question of the regulation of wooden buildings and structures has always been one of great difficulty; there are many old erections that cannot be touched by reason of their age; again many are undoubtedly constantly being put up in back yards and similar places out of sight, and it is only by chance that they are discovered and proceedings taken. The law on this subject needs strengthening, whereas the transfer of the licensing power has distinctly weakened it. These wooden erections are a real danger to the public; the licensing power

Wooden Structures Dangerous.

must be returned to the County Council, and an enactment should be passed similar to that now existing for sky signs, requiring the entire removal of all objectionable buildings and structures, old and new, within a short time, and the periodical licensing of the remainder for two years at most at each time, the district surveyor being required to report on each structure at each renewal as in the case of sky signs, now happily obsolete in London.

Provisions for Exit in Case of Fire.

The important question of exit in case of fire has hitherto been most imperfectly dealt with in the past and present Building Acts; in fact, until the passing of the Act of 1894 it had all but been ignored.

The only class of building dealt with in that Act in any way adequately is one division of public buildings, viz., places of public resort. Section 80 provides a fairly good set of rules for churches, chapels, public halls and similar buildings, giving minimum widths according to the number of persons to be accommodated, and requiring separate exits for each floor or gallery with all doors to open outwards. The weak point of this section is that a single exit for each portion of the building is all that is required, a second exit being only necessary where the width of the exits are reduced to two-thirds of the minimum. In my opinion at least two exits should be required to all parts accommodating more than about 100 persons. Of course theatres, concert halls and all premises licensed for music and dancing are also dealt with under the L. C. C. regulations made under the Act of 1878, and these require two exits in every case; but this still leaves all other buildings with only one exit compulsory.

S. 80

Fire Escape Law very Defective.

The stairs, corridors, passages and landings of all public buildings are required to be constructed of and supported on fire-resisting materials; but beyond that there are no provisions for the number, size or situation of staircases and exits from such public buildings as hotels, hospitals, schools or asylums.

S. 68

Buildings exceeding 60 feet in height (this will probably include public buildings) must be provided "with such means

S. 63

Buildings Over 60 Feet High.

of escape in case of fire from the stories more than 60 feet above the street as can reasonably be required under the circumstances of the case," and the County Council's certificate that this has been complied with must be obtained before the upper portion of the building can be occupied.

This form of legislation is most unsatisfactory; it places the person about to build either under the arbitrary rule of an official of the Council (perhaps a subordinate), or subject to the whims and fads of a committee of men probably not technically versed in the subject. Every architect about to design a building has a right to know what the law requires of him, and the provisions should therefore be set out definitely in the Act, or in some by-laws made under the Act, and be enforced by the district surveyor. This section is an importation into the London law of the objectionable provincial system, and it is to be noted that there is no appeal from a decision of the Council.

A section in the Act requiring a fire-resisting staircase on fire-resisting supports and inclosed with fire-resisting walls, and also a second way of escape by means of the roof to an adjoining house, or by an external iron staircase or bridge to some other building or to the ground, would, I think, meet the case.

Fire Escapes for Tenements, etc., Inadequate.

The provisions as to staircases and exits from tenement buildings or flats are most inadequate; unless these buildings exceed 125,000 cubic feet there is no provision whatever, and for buildings exceeding that cube the only requirement is that

S. 68

the stairs and corridors shall be fire-resisting. A building containing hundreds of tenements may be constructed with only one staircase. I have already suggested that these buildings should be limited in size; each of these subdivisions should have its separate staircase and exit to the outer air on the ground level.

S. 61 (2)

The only provision for exit from ordinary dwellings is that if exceeding 30 feet in height and having a roof parapet, there shall be a trap door or dormer by means of which access can be obtained to the roof. This may be no exit at all where the adjoining roofs are inaccessible.

It was the intention of the framers of the 1894 Act that all buildings exceeding 10 squares in area used partly for trade and partly for dwelling should, in addition to the fire-resisting separation, be provided with a means of escape from the dwelling; unfortunately the text of the Act does not properly carry out that intention, as such provision is only inferentially required by the section. The means of approach to the dwelling portion referred to will naturally form part of the dwelling division, and as such must be separated from the trade portion; this will entail an approach from the outer air, but not necessarily from the street. An attempt was made in the case of Carritt v. Godson (63 J. P., 644) to enforce an exit to the street: this of necessity failed, and I cannot help thinking that this case was very unwisely taken into court, unless indeed it was the intention to at once amend the Act in case of an adverse decision. The remark made by Mr. Justice Day that with an exit into a back yard you might get scorched but not necessarily burnt, and that the object of the section would thus be partly obtained, "which is always something to be thankful for," is certainly quaint. S. 74 (2)

The section of the Act prohibiting buildings being erected or extended beyond the general line of buildings has been indirectly productive of death traps. Where consent is given the building line in advance of the line is in all cases limited to 16 feet in height, but no attention is paid to the exits from the building. A tall building some 50 feet back from the road, shut in entirely behind a one-story shop, is quite inaccessible by a fire escape, and the natural exit may be entirely shut off by reason of the shop being in flames. Should the building exceed 10 squares in area the imperfect provisions of section 74 would apply, but they would be practically useless, as has many times been demonstrated when a fire occurs in a building of this construction. Unless there be an adequate exit into a side or back street, a proper exit 3 feet wide separated from the shop by a fire-resisting partition should be required to the front street. The roof or flat over all shops projecting more than 3 feet from the main wall of the building should be required to be entirely of fire-resisting construc- S. 22. Building Line and Dangers.

tion, and no skylight should be allowed within 6 feet of the main building; at present the skylight is usually placed immediately under the windows of the first floor, so that in case of fire these windows become impossible as emergency exits. New legislation is not in all cases required to effect this imperative improvement; the County Council have this matter entirely in their hands in the case of each new application, as they have by section 26 power to impose any condition they may deem expedient in the public interests.

Factory Exits

The exits from factories are dealt with under the Factory and Workshops Act, 1901, section 14: Every factory must be furnished with the certificate of the County Council, that it is provided with such means of escape in case of fire as can reasonably be required under the circumstances of each case. This form of legislation is bad in principle for the same reasons as in the case of buildings more than 60 feet high, where a similar enactment is contained in the Building Act; but after many years of worry and friction the Council have now issued (July, 1902) a list of general requirements for the public guidance, which are in many respects admirable.

The Factory Act applies to the whole of the kingdom, and has therefore been drawn on the provincial principle that the local authority enforces the building by-laws; it is therefore somewhat out of key with the London law, where the district surveyor has the administration. This has evidently not been entirely overlooked, as in the part dealing with the application of the Act to London power is given to the County Council (section 153 [7]) to make by-laws under section 164 of the London Building Act, with respect to the means of escape from fire in factories and workshops; when made these by-laws will be by-laws under the Building Act, and as such will be administered by the district surveyor.

The provisions of the Factory Act do not apply to warehouses, nor to any buildings except factories so defined under that Act; nor are there any provisions on that subject in the Building Act, except the trap door to roof required where the building exceeds 30 feet in height and the roof has a parapet.

S. 61 (2)

Exemptions.

The exemption sections of the Act require careful revision; circumstances have very considerably altered since these exemptions were originally allowed. It is evident that a building situated some distance from adjoining buildings, that might reasonably be exempted from provisions aimed at preventing the spread of fire from building to building, is not necessarily one that should be exempted from provisions regulating the construction of the building to secure prevention from fire or exit in case of fire. Speaking generally, exemptions of particular buildings or buildings in particular ownership are not justifiable; if provisions are necessary in the public interest all should be subject to those provisions; exemptions should therefore be reduced to a minimum. It is impossible to justify, except by favoritism, the exemption of such buildings as the Mansion House, Guildhall, Bank of England, the Sessions Houses, Covent Garden Market, Deptford Cattle Market, or the buildings of the Inns of Court.

The exemption of dwelling-houses of less than stated sizes, and exceeding certain distances from adjoining property, are no longer tenable, as many of the provisions of the Act concern the construction of and exit from the building, and not merely its protection from neighboring buildings.

Railway Structure.

Another class of exemption that needs careful reconsideration is the exemption of the Railway, Dock, and Gas Companies; it was intended that the exemption should only extend to buildings used exclusively for the company for its own use, but the operation of the exemption has been considerably extended by the decision of the Divisional Court in the case of Elliott *v.* L. C. C. (63 J. P., 645), which allowed the exemption of a wooden building erected by a firm of coal merchants on the premises of the railway company, and used as an office in connection with the sale of coal by the firm, the coal being carried by the railway company; this was held to be "used for the purposes of or in connection with the traffic of a railway company." In this case the object of the section was not even partly obtained, so there is nothing to be thankful for.

The time has, I think, elapsed, for allowing a railway or any other company to cover large areas with inflammable buildings; the only argument in favor of the exemption of railway companies is that the control is in the hands of responsible engineers; but this does not prevent the erection of inflammable buildings even contiguous to dwelling-houses. There are some very extensive office buildings erected by railway companies entirely of wood; surely the hundreds of clerks are entitled to the protection of the Building Act.

Application of Existing Laws to Old Buildings.

I now come to the burning question (in more senses than one), whether the provisions of the Act, or any of them, should be made applicable to existing buildings. As the law at present stands, the London Building Act controls the construction of only newly erected buildings, and alterations, additions and other works done to existing buildings on the initiative of the owner of those buildings: there is no provision for the compulsory alteration of existing buildings to bring them more up to date.

This is a very serious subject. The owners naturally look upon any attempt to amend their buildings as an interference with the rights of the individual, and the Act rather supports this view, containing, as it does, many provisions for the maintenance of vested interests, even in the erection of new buildings on the site of old. But there is a vast difference between relaxing the rules of the Act when the width of a street is involved and when the lives and health of persons are at stake. Vested interests in property are one thing, but no man has a right to a vested interest in endangering the lives of his fellow men, even though they be his employees.

The right of the authorities to interfere and demand structural alteration when the lives of others are endangered has for many years been recognized in various Acts.

The Building Act itself, in Part IX., provides excellent machinery for the demolition or amendment of buildings in a dangerous condition.

The Metropolis Management and Building Act, 1878, provides not only for the safety of the public in new theatres and other licensed places of assembly, but also gives the

County Council power "where special danger from fire may result to the public," to cause structural amendments to be made to remedy the evil.

The Factory and Workshop Act, 1901 (following on the repealed Act of 1891), in section 14, provides for the safe exit of persons employed in a factory erected before as well as after 1891; the Authority (in London, the County Council) having the same power in old buildings as in new.

The public health Acts provide for the abatement of nuisances in all buildings, old and new.

There is, therefore, plenty of precedents for applying to existing buildings such provisions as are required for new, for the safety of life, limb and health. The number of new buildings is very small compared to that of existing buildings; by applying, therefore, these provisions to new buildings only we are making very slow progress: and we cannot, I think, logically go on enforcing the law as to new buildings without requiring some amendment of the numerous death traps that exist. The owner of a factory may be required to provide proper exits for those employed in it, but should he discontinue the manufacture of goods and merely store or sell them, the building is then a warehouse, and as such the exits, no matter how dangerous, cannot be interfered with.

County Council should Enforce Law Regarding Present Buildings.

A reasonable amount of control of existing buildings has, I think, been shown by recent fires to be necessary.

But while there is precedent for the compulsory alteration of existing buildings, there is, as far as I know, no precedent for allowing repeated interference with the same building for the same defect: the power must be exercised once for all. That is the principle of law laid down by Mr. Justice Channell in the case of St. James's Hall Company *v.* L. C. C. (84 L. T., 568). In this case the late Metropolitan Board of Works had in 1885 exercised their right under the Metropolis Management and Building Amendment Act, 1878, in respect of the St. James's Hall, to which they had required certain amendments, which had been carried out: subsequently the L. C. C. sought to again exercise their authority and made a further requisition, but the Court held that this could not be enforced,

as the Metropolitan Board of Works had already exhausted the power to demand amendment.

I think, therefore, that it must be accepted that any power conferred on the authority (whoever that may be) to require the amendment under the Building Act of any existing building, must be exercised once for all; this unfortunately was not the proposal of the L. C. C. in the bill of this year, now withdrawn.

The Glasgow Building Regulations Act, 1900, while making provisions for the compulsory alterations to existing buildings, so far as regards the exits from warehouses and high buildings, recognizes this principle, and requires the work to be done within five years of the passing of the Act (30 July, 1900).

The question as to who shall exercise the power of demanding and enforcing these alterations is a very important one; it must clearly be in the hands of an authority that would exercise a uniform control over the whole of London; it will therefore be impossible to parcel it out to different authorities acting over confined areas, and it would, I think, be throwing too much personal responsibility on the district surveyors to ask them to undertake the task. Similar duties are already exercised by the L. C. C. in the case of dangerous structures and the theatres and the Factory Act; they are also the present authority for special consents under the Building Act; and in addition the area of their administration is coterminous with that of the Building Act. There can, I think, be no two opinions that they are the proper authority to exercise this power, subject to the right of the owner to appeal to the Tribunal of Appeal.

The present dangerous structure procedure would form a good model for these cases. The district surveyor might be asked to report upon the building. Acting upon his report the L. C. C. might formulate their requisition, and the owner might have, say, one month in which to appeal to the tribunal, who might, if necessary, revise or cancel the requisition. When the work to be done has finally been decided upon, copies of the drawings and requisition should be sent to the

district surveyor to see the work carried out, and on completion he should issue a certificate to the Council and the owner that the work had been completed, which certificate should be a guarantee that the owner will not be required to further amend the building unless he should himself voluntarily make additions or alterations to it, in which case the rules for new buildings will of course apply.

It has been urged in the City that the Court of Common Council should administer the proposed law within the City; but this cannot be accepted, as the very persons on whom the notices would fall would, in many cases, be members of the authority to enforce those notices; no man would make a rod for his own back; again, this would destroy the necessary uniformity of administration throughout London. The time has, I think, passed for making any exception in favor of the City; those made in the past have been the outcome of petty jealousy, and exist to the detriment of good building and sanitation.

BERNARD DICKSEE.

APPENDIX A.

SUGGESTED NEW SECTIONS TO CARRY INTO EFFECT SOME OF THE AMENDMENTS OF THE LAW SUGGESTED.

SEPARATION OF BUILDINGS.

In substitution for section 74 (1).

1. Every building shall be separated from each of the adjoining buildings by external or party walls or by party arches or party floors.
2. If any building exceeding 10 squares in area be divided into two or more tenements, each having a separate entrance and staircase, or a separate entrance from the outer air, every such tenement shall be deemed a separate building and shall be separated accordingly.

Separation of Tenements within a Building.

In substitution for section 74 (3) *and* 68.

Cubical Contents Allowable for Different Buildings.

1. In every building exceeding 100,000 feet in cubical extent separate sets of dwelling rooms tenanted or constructed or adapted to be tenanted in different occupations shall be separated from each other by walls, partitions and floors constructed of fire-resisting materials; and from the common staircase or other approach by walls constructed of brick, stone, or other hard and incombustible substances of the thickness prescribed for cross walls; and the floors of the common corridor and passages and also the landings and stairs of the common staircase approaching thereto, shall be constructed of and be carried on supports of fire-resisting materials.

   No such building shall extend to more than 250,000 cubic feet, unless divided by party walls in such manner that no division thereof shall extend to more than 250,000 cubic feet, and each such division shall be provided with a separate staircase and entrance affording a direct means of approach from each set of dwelling-rooms in that division to a street or public open space.

2. In every building exceeding 100,000 feet in cubical extent containing separate sets of offices or rooms (other than dwellings) tenanted or constructed or adapted to be tenanted by different persons, the floors and the principal staircases and corridors shall be constructed of and carried on supports of fire-resisting materials, and the walls of such staircases shall be of the thickness required for cross walls.

   No such building shall extend to more than 250,000 cubic feet, unless divided by party walls in such manner that no division thereof shall extend to more than 250,000 cubic feet, and each division shall be provided with a separate staircase and entrance affording a direct means of approach to a street or public open space.

SEPARATION OF TRADE PREMISES FROM DWELLING-ROOMS.

In substitution for section 74 (2).

1. Every building exceeding 10 squares in area and used or constructed or intended to be used jointly for the purposes of manufacture or trade (whether wholesale or retail) and for dwelling shall be structurally divided into a part or parts to be used for the purposes of manufacture or trade and a part or parts to be used for dwelling.
2. The part or parts to be used for the purposes of manufacture or trade shall be separated from the part or parts to be used for dwelling, by walls and floors constructed of fire-resisting materials, and all such walls shall be at least four inches in thickness, or if more than 10 feet in height and not built in cement at least 8½ inches in thickness.
3. All openings made in the walls and floors of fire-resisting materials shall be closed by doors and frames of fire-resisting materials bedded solid to the wall or floor.
4. There shall be provided to the part or parts to be used for dwelling, a separate means of approach from a street or from an open space, from which reasonable access can be obtained to a street, and all staircases and passages forming such means of approach shall be included within the part or parts to be used for dwelling and shall be constructed throughout of fire-resisting materials.
5. Where the building extends to more than 50 squares in area, two such means of approach shall be provided separate and distinct from each other.
6. All buildings used or to be used wholly or in part for the purposes of manufacture or trade, whether wholesale or retail, shall, so far as regards the part used for the purposes of manufacture or trade, be subject to the provisions of the Act of 1894, and any amendment relating to the cubical extent of buildings of the warehouse class.

Width of Way.

In substitution for section 13 (5), *first proviso and amendment,* 1898.

Provided always that no dwelling to be inhabited or adapted to be inhabited by persons of the working class, shall, without the consent of the council, be erected or re-erected within a distance of 20 feet from the centre of the roadway, so that the height of the ceiling of the top-most story above the footway shall exceed 20 feet more than the distance of the front or nearest external wall of such building from the opposite side of such street; and that no building or structure shall be converted into such dwelling house so as to exceed such height.

Uniting Buildings.

In substitution for section 77 (1) *b.*

Openings in Floors and Party Walls.

Such opening shall have the floor, jambs, and head formed of brick, stone or iron, or other fire-resisting and non-combustible material, and shall be closed by a pair of party wall doors at a distance from each other of the full thickness of the wall. Such party wall doors shall be of iron at least one-fourth of an inch thick in the panel, and be either hung on pivots and fitted close to rebated iron frames, and secured by bolts or other fastenings at the top, middle, and bottom of each style, or sliding doors or shutters fitted close at all edges into grooved or rebated iron frames; and such party wall doors shall be constructed and fitted in all respects to the satisfaction of the district surveyor.

Provided that the council may by by-laws or otherwise, after consulting with the District Surveyors' Association, approve the use as party wall doors of doors of fire-resisting material otherwise constructed.

Additional to section 77 (1) *c.*

Provided that the council shall have power where they think fit to allow such opening to be constructed of a width not exceeding 9 feet.

Additional to section 77.

Where any opening or openings have at any time been made in any party wall or in two external walls dividing buildings, the making of any subsequent opening in such party wall or two external walls shall, notwithstanding, be deemed to be a uniting of buildings, and no such subsequent opening shall be made except in accordance with the provisions of the principal Act or any amending Act as to the uniting of buildings.

Additional.

Where, before the passing of this Act, any openings have been made in any party wall or in two external walls dividing buildings, the owner or occupier of such buildings shall within six months of the commencement of this Act make application to the district surveyor for a certificate as to such openings. Every such application shall state the situation, area, height, number of stories, use of each building, and the name and address of each occupier and tenant, with particulars as to their occupation and such other information as the district surveyor may reasonably require. On receipt of such application the district surveyor shall make a survey of the buildings, and if the openings be found to be in accordance with the Act he shall issue a certificate to that effect; but if the openings be found to be in any way irregular, he shall cause the same to be amended or built up, as the circumstances may require.

In the case of openings constructed after the passing of this Act the district surveyor shall issue his certificate on completion of the opening.

The certificate shall run for two years from the date thereof, and at the expiration of that time application shall be made by the owner or occupier for the renewal, when the same provisions shall apply.

Any person who neglects to make application to the district surveyor for his certificate as aforesaid shall be liable to a penalty not exceeding £5, and the district surveyor may

take all proceedings as though application had been made.

Any person who makes an opening in a party wall or in two external walls dividing buildings without giving notice to the district surveyor, shall, in addition to the penalty for neglecting to give building notice, be liable to a penalty of not exceeding £20.

Additional.

Where a party wall separates buildings of different heights and in different occupations, such wall shall be deemed a party wall for the full height of the higher building, and no opening shall be made in any portion of the wall except in accordance with the provisions of the Act of 1894 and any amending Act as to the uniting of buildings, or as provided in section 101 of the Act of 1894.

LIMIT OF CUBICAL EXTENT OF TRADE PREMISES.

In substitution for section 75 (first two paragraphs):

No building of the warehouse class or other building used or to be used either wholly or in part for the purposes of manufacture or trade, the floors of which are not constructed of fire-resisting materials, shall extend to more than 100,000 cubic feet, unless divided by party walls in such manner that no division thereof extends to more than 100,000 cubic feet. Provided that where the floors of such building are constructed of fire-resisting material the building or division may extend to not more than 250,000 cubic feet.

No addition shall be made to any existing building exceeding the aforesaid limits of cubical extent, unless the building be altered to comply with this section: nor shall any addition be made to any building nor to any division thereof, so that the cubical extent of such building or division shall exceed the aforesaid limits.

Construction of Warehouse Buildings.

Additional.

The following provisions shall (except with the consent of the council) apply to buildings of the warehouse class and all other buildings used or to be used for the purposes of manufacture or trade.

1. The roofs, flats, and gutters of every such building and every turret, dormer, or other erection thereon shall be constructed solid of fire-resisting materials, except the necessary woodwork of doors and frames, windows and frames, skylights and lantern lights.
2. The external walls abutting upon any street or upon any court or light well connected with or adjoining to such building shall, where within a distance of 20 feet from any other buildings opposite thereto, be carried up as a parapet at least 8½ inches thick for a height of 3 feet above the roof, flat, or gutter. And all windows in such walls and any skylights or lantern lights lit from such street, court, or light well, shall be either fitted entirely with metal frames and glazed with wired glass, or be fitted with fire-resisting shutters capable of being closed and fastened from the inside.
3. In all such buildings exceeding 10 squares in area, the principal staircases shall be constructed of and carried on supports of fire-resisting materials, and shall be inclosed with walls or partitions of fire-resisting materials carried up to the roof, or where such staircase does not extend to the top of the building be covered in with a floor of fire-resisting materials. And the corridors and passages from such staircases communicating with the street shall be similarly constructed and inclosed.

Protection of Metal from Fire.

Additional.

Every metal girder, stanchion, column, or story post supporting a wall or a floor or partition required by this Act to be of fire-resisting material, shall be protected from

the action of fire by being encased to the satisfaction of the district surveyor in concrete, brickwork, terra cotta, or metal lathing and plaster or cement without woodwork of any description. Should any person be dissatisfied with the decision or requirements of the district surveyor he may appeal to the tribunal of appeal.

Wooden Boarding and Paneling.

Additional.

1. No wooden boarding or paneling shall be fixed as a lining to walls, partitions, ceilings, or soffits, in any building of the warehouse class, nor in any other building used or to be used for the purpose of manufacture or trade, nor in any shop or room used in conjunction therewith, unless all the floors, ceilings, flats, soffits, walls, and partitions inclosing the room or other space in which such boarding is fixed be constructed entirely of fire-resisting materials, or the spaces between the joists or studs be filled in solid with brick, concrete, or other fire-resisting materials, and there shall be no space between such wooden boarding or paneling and the wall partition, floor, ceiling, or soffit, to which it is affixed, other than the thickness not exceeding one inch of the battens necessary for fixing such boarding or paneling.
2. No wooden boarding or panelling shall be fixed as a lining to walls, partitions, ceilings, or soffits in any dwelling-house unless the floor, wall or partition, or the ceiling or soffit (other than to a roof or flat over which there is no room) to which such boarding or panelling is affixed be constructed of fire-resisting materials, or the space between the joists or studs be filled in solid with brick, concrete, or other fire-resisting materials.

Internal Partitions and Walls.

Additional.

1. All interior walls and partitions (other than partitions constructed of wooden boarding or panelling) shall, so far as regards the lowest story at least of such wall or

partition, where adequate support is available upon the solid ground or upon a brick wall, or upon a metal girder, be constructed of brick, stone, concrete, or other incombustible material.

2. The spaces inside any partition constructed of timber framing shall be filled in solid with brick, stone, concrete, or other incombustible material from the level of every ceiling up to the level of the top of the skirting of the story immediately above.

ONE-STORY PROJECTING SHOPS, &c.

Additional.

1. The roof or flat over any shop or other premises used for the purpose of manufacture or trade, projecting beyond the main front flank or rear wall of the building of which it forms part, and abutting upon a street or open space adjacent to a street, shall be constructed throughout of fire-resisting materials. And no skylight or lantern-light shall be placed on such roof or flat within 6 feet of any such wall in which there are windows, but all such skylights and lantern-lights shall be so situated as to afford a clear gangway at least 4 feet wide from such windows to the frontage abutting on the street or open space aforesaid.

2. There shall be provided to the stories above the ground story of such buildings a means of approach at least 3 feet in width from a street or from an open space from which reasonable access can be obtained to a street, and where such means of approach passes through, along, or across the aforesaid projecting shop or premises used for manufacture or trade it shall be separated therefrom by walls, floors, and partitions of fire-resisting material and shall be constructed of fire-resisting materials.

EXIT FROM CERTAIN BUILDINGS.

In substitution for sections 63 *and* 68.

In every public building, and in every building the upper surface of the top floor of which is more than 60 feet

above the level of the street, and in every building of the warehouse class and every other building used for the purpose of manufacture or trade, there shall be provided exits from the building by means of one or more staircases communicating with the various parts of such building, constructed throughout of fire-resisting material and carried upon supports of and inclosed by walls of fire-resisting material, and the floors of all lobbies, corridors, and passages communicating therewith shall be constructed of fire-resisting materials. There shall also be provided to such building an additional means of escape in case of fire either by a second staircase as aforesaid, or by an external iron staircase or bridge communicating with the ground or with some other building from which access can be obtained to the street, or by some other means that may be approved by the council, or on appeal by the tribune of appeal; and the council may make by-laws under section 164 of the principal Act with respect to such additional exit.

REGULATION OF EXITS OF EXISTING BUILDINGS.

Additional.

1. In the case of any building erected before the passing of this Act that is either
   (a) a public building, or
   (b) a building, the upper surface of the top floor of which is more than 60 feet above the level of the street, or
   (c) a building of the warehouse class or other building used for the purpose of manufacture or trade.

Where it is made known to the council that the said building is so defective in its structure that special danger from fire by reason of the insufficiency or inadequacy of the means of exit may result to the persons dwelling or employed therein or frequenting or resorting thereto, the council shall require a survey of such building to be made by the district surveyor.

2. The district surveyor shall make known to the council any information that he may receive with respect to any structure being in such state as aforesaid.
3. For the purposes of carrying this section into effect the council may cause such inquiries to be made respecting each building as they may think fit.
4. It shall be lawful for the district surveyor to enter into any building or upon any land upon which any building is situate, for the purpose of making a survey of such building.
5. Upon completion of his survey the district surveyor shall report to the council his opinion as to the condition of the building and the reasonable means to be adopted to remedy such deficiency or inadequacy of exits as aforesaid, if any.
6. If the certificate be to the effect that such deficiency or inadequacy exists the council may cause a requisition to be served on the owner or occupier of the building requiring him to cause such works to be done as can reasonably be demanded under the circumstances of the case. Any person dissatisfied with the requisition of the council may within 21 days of receipt of same appeal to the tribunal of appeal, who shall hear and determine such appeal and may affirm, alter, amend, or disallow such requisition.
7. At the expiration of 21 days aforesaid should no appeal have been lodged or where such appeal has been lodged, then upon the decision of the tribunal of appeal a copy of all plans and particulars of any works approved or required by the council under this Act shall be furnished by the council to the district surveyor within whose district the building to which such plans and particulars relate is situate and it shall be his duty to ascertain that the same is built in accordance with the said plans and particulars.
8. Upon the completion of the required works by the owner or occupier the district surveyor shall issue a certificate to the owner or occupier and to the council that the

works have been done in accordance with the requisition of the council or of the Tribunal of Appeal as the case may be. After the issue of such certificate no further requisition shall be served by the council in respect of the same building.

9. If the owner or occupier fail to comply as speedily as the nature of the case permits, the council may cause a complaint to be made at a Petty Sessional Court, and the proceedings shall be in all respects where the same are applicable the same as in the case of dangerous structures.

Criticisms and Suggestions Regarding London Building Laws, as Indicated by Causes Productive of Recent Large Fires.

In connection with the above Paper and Appendix A, the following letters of the British Fire Prevention Committee's Executive to various Public Authorities and to the Press, as also certain extracts from official publications, are presented:

APPENDIX I.

(Letter to the Public Press.)

Re Barbican Fire.

To the Editor of

Sir—The attention of the Executive of this Committee having been given to the Barbican Fire on Monday, 1st, which in many ways is a repetition of the worst features of the Cripplegate conflagration of 1897, we think it only right on this occasion to call the attention of the warehousemen and ground landlords, as well as the public authorities controlling these areas, and the insurance companies (who have considerable influence on building matters), that neglect is being shown, even

in the better class of warehouse buildings, to the protection of the vertical surface occupied by the window openings overlooking thoroughfares, areas, and courts, and that it is imperative that such openings in the vertical surfaces should be protected in some form or the other. This protection can be effected by using less flammable materials for window-frames; in many cases, by using fire-resisting glazing; and, further, by fitting the openings with fire-resisting shutters or blinds, or by equipping them with drenchers.

It is obvious that in the Metropolis the risk of fire spreading from house to house across streets even over forty feet wide (as in the case of the Barbican fire) should be limited by preventive measures, which, although not inexpensive, become absolute necessities in localities where the householder's danger is not a question merely of accident or neglect in his own premises, but where he has to be constantly on his guard against risk from his neighbors.

With more rapid measures, automatic or otherwise, of summoning the fire-fighting forces, and the instant use of first aid fire-extinguishing appliances, the possibilities of extensive conflagrations would be more remote, and much that this Committee must now consider necessary in the form of better building construction might perhaps be modified; but given existing circumstances, the importance of fire prevention by better construction and more particularly by a reduction of the spread of fire from house to house, is becoming even more essential now that the City population is decreasing, whilst mercantile structures are rapidly taking the place of dwellings.

We take the occasion to emphasize only the one serious question of the protection of vertical openings, although there are many points that deserve attention, more particularly the protection of all ironwork by suitable covering; the avoidance of building materials which, when heated by fire, are liable to disintegrate on the application of water; improved forms of roof construction, and the protection of skylights. But to deal in detail with those would lead too far. We desire to point out that, under the present circumstances of the Metropolis, the prevention of the spread of fire from neighboring property is

of far greater importance than in many other cities, and that means exist by which this risk can be reduced.

We are, Sir,
Yours very truly,
On behalf of the British Fire Prevention Committee,
(Signed) EDWIN O. SACHS, Chairman.
(Signed) ELLIS MARSLAND, Hon. Secretary.
1 Waterloo Place, Pall Mall,
April 23, 1902.

APPENDIX II.

(Letter to the Corporation of the City of London.)

Re THE QUEEN VICTORIA STREET FIRE.

(THE BUILDING ACT.)

The Clerk, the Corporation, the City of London.

SIR—In connection with the sad loss of life at the General Electric Company's premises in Queen Victoria Street, the Executive of this Committee at its meeting of this afternoon desires us to call your attention to the following:—

(1.) It is notorious that many offices and warehouse buildings must necessarily be used temporarily for manufacturing purposes, and that individual rooms or floors have frequently to serve as workshops.

(2.) Legislation, as it stands to-day, gives the public authorities considerable control over scientific classes of buildings erected for specific purposes, but there is little or no control exercised as to the use of buildings or parts of buildings for purposes other than those for which they were originally intended.

(3.) It is in such buildings that the congregation of a large number of workers becomes exceedingly perilous, and the sad loss of life on this and other occasions only too clearly shows the absolute necessity of greater severity in controlling the use to which such buildings are put.

(4.) The serious loss of life on this occasion, following so shortly upon a series of deaths in buildings partially used as business premises and partially used as tenements (we would here particularly refer to the fires at Hackney and St. Luke's), make it evident that revision in the interests of human safety is required in more than one direction, *i.e.*, more especially also in shops with dwellings above.

(5.) Our Executive wish to urge most emphatically that fire-prevention legislation requires revision, and that to make it effective it must be of a *retrospective* character.

(6.) At the same time we would like to point out the personal responsibility which rests with the owners of the building and the employer of labor in seeing to the safety of the staff, and that this responsibility should be recognized and clearly defined by law.

(7.) The Executive does not wish to hastily define what they consider to be the reasonable requirements to limit loss of life, but it is their unanimous opinion that a ready and easy means of escape should be provided from the upper part of *every* building in the City of London, both new and old, and that practical effect should be given to this without undue complication of expense.

We are, dear Sir,

On behalf and at the direction of the Executive of the British Fire Prevention Committee,

Yours very truly,

(Signed) EDWIN O. SACHS,
Chairman.

(Signed) ELLIS MARSLAND,
Hon. Secretary.

1, Waterloo Place, Pall Mall, S.W.,
June 12, 1902.

APPENDIX III.

Extract from Report to the Court of Common Council from the County Purposes Committee. Presented 26th November, 1902.

To the Right Honorable the Lord Mayor, Aldermen, and Commons of the City of London, in Common Council assembled:—

We, whose names are hereunto subscribed, of your County Purposes Committee, to whom it was referred by your Honorable Court . . . . :—

. . . . "To consider a letter from the British Fire Prevention Committee in connection with the loss of life at the recent fire in Queen Victoria Street, urging that fire prevention legislation requires revision, and that a ready and easy means of escape should be provided for the upper part of every building in the City, both new and old.

APPENDIX V.

(*Letter to the London County Council.*)

DEAR SIR—I am instructed by the Executive of the British Fire Prevention Committee to forward you the inclosed* observations and suggestions on the Building Act Amendment Act, with the request that your Council kindly give them their consideration.

Your obedient servant,
(Signed) ELLIS MARSLAND,
Hon. Secretary.

The Clerk, London County Council,
Spring Gardens, S.W., 10th February, 1903.

BUILDING ACT AMENDMENT ACT, 1903.

*Observations and Suggestions by The British Fire Prevention Committee.

(Founded 1897. Incorporated 1899.)

As considered and authorized for submission to the London County Council on Monday, February 9, 1903.

From the fire-prevention point of view, and considered from that point only, the proposed Bill is, in the opinion of the British Fire Prevention Committee, an advance in the right direction, but some of the provisions appear to be vague, and will, if passed in their present form, make it difficult to ascertain how the requirements—which are retrospective—will apply.

General Observations.

The following are the general points to which the Committee desires to call the attention of the Council:—

All classes of buildings should not be treated alike; it is only reasonable that schedules defining different classes of buildings and different requirements should form part of the Bill.

It may be difficult to frame such schedules so that they should apply to every case, but it is possible to do so in a manner which would suit the large majority, and thus save arbitration and litigation except in a few cases.

As an illustration, banks and offices are classed in the proposed Bill with workrooms and warehouses, whereas buildings of such different character should be treated separately under the proposed schedules.

Various sections of the Bill imply that inclosed fire-resisting staircases will be generally required in buildings to which the retrospective clauses apply, but outside balconies and ladders to same would, in numerous cases, give adequate security and facilitate the work of the fire brigade.

Observations in Detail.

Dealing with the sections and clauses in detail, the Committee further submits the following suggestions for consideration:—

Section 9. It would be preferable to state that the inclosing material to internal staircases should be brickwork at least 9 inches thick for the more hazardous classes of building.

Section 10. Referring to the previous remarks as to schedules of requirements, it is suggested that balconies and ladders to the front and back of buildings may be provided as an alternative to staircases. In many cases they would be more suitable than staircases.

Section 17. *Clause* 1. It is desirable that the materials for the construction of party structures should be defined by schedule.

Clause 2. In every building in which it is necessary to make the floors and partitions fire-resisting, it is equally necessary to make the passages, landings, and staircases of similar materials.

Clause 6. The number of escape passages and staircases should be regulated not alone by the width of frontage, but also by floor area. The minimum width given for passages and staircases, viz., 2 feet 6 inches, is too narrow and should be at least 3 feet.

Clause 7. The storage of inflammable materials under and on staircases or landings should be prohibited.

Clause 9. The size of doors on the staircases should be limited, and a definition should be given as to what constitutes a " self-closing " door.

Clause 10. It is desirable that the word " pugging " should be omitted. The method of applying concrete and holding it in position between wooden joists should be clearly defined, and the underside of all such floors should be plastered.

Section 18. Lantern lights in fire-resisting roofs over the projecting portion of shops might be allowed nearer than 4 feet from the main front wall of the building, where not opposite to a window. Iron lights with wired glass in small squares should be compulsory in all such skylights.

Section 19. *Soft-wood* boarding and panelling should clearly be prohibited in the more hazardous classes of building defined by schedule.

Section 20. The fire-resisting inclosures to lift-shafts, where carried to the top of the building, should be continued through the roof and covered with thin glass, protected on the outside with strong wire-work. Lift-shafts not reaching the foundations of buildings should have the bottom closed with 5 inches of concrete. Doors of lifts should be self-closing.

Further Suggestions.

In an Amendment Bill, part of which is intended to secure "the reduction of the risk of fire" in buildings in London, it is desirable to provide for the following further amendments:—

1. All stoves and chimney-pieces which are set in chimney openings should be required to be set solid in brickwork, so as to avoid cavities at the back and sides in which soot may accumulate.

2. No wooden plugs or iron hold-fasts should be driven into brickwork surrounding flues. If skirtings or the like are required, cement should be used.

3. Iron or steel joists or other iron work built into flues or under hearths should be prohibited.

4. Disused chimney-flues or fireplace-openings should be stopped with incombustible material.

5. Brickwork 9 inches thick for certain flues is allowed to terminate at the level of the ceiling of the room next above the apparatus; this height should be extended to the level of the *floor-boards* above such ceiling.

6. The schedule of fire-resisting materials should be revised.

7. Every chase in any wall shall be properly stopped at every floor-level with fire-resisting material of the full thickness of the floor, except so much thereof as is occupied by pipes.

8. All constructional ironwork should be protected with at least 2 inches of plaster or cement or other incombustible material or non-conducting external coating.

9. All windows to buildings of a hazardous character in streets of less width than 25 feet, and all windows of such look-

ing into areas or open spaces where they come within 25 feet of windows opposite thereto, should be fitted with curtains, shutters or blinds of fire-resisting materials, to efficiently cover the same, or shall have metal sashes glazed with fire-resisting glass.

On behalf of The British Fire Prevention Committee,

(Signed) ELLIS MARSLAND,
Hon. Secretary.

10th February, 1903.

DISCUSSION.

Mr. ELLIS MARSLAND (District Surveyor, Camberwell, London)—I am sure we are all very much indebted to Mr. Dicksee for the excellent resume he has given us of the London Building Act, and the way he has exposed some of its defects. I think he has rightly called attention to some of the very serious defects that Act contains as to the protection of buildings from fire. There are three points I think we ought to emphasize in a Congress such as this. It has been shown over and over again that the windows are most often the source from which the fire spreads from one building to another. Yet we have no provision in the London Building Act—and I do not know that provision is made in regard to any municipality in the country—as to the protection of windows, especially where they are surrounding light wells. I think if such windows could be given some protection, such as wired glass with steel frames, steel or wire shutters, or tin-lined shutters, as are used in New York—it would be a great advantage, and prevent the spread of fires. Another great thing that must be insisted on is the protection of ironwork. People think that once they have their buildings constructed of iron they have a fire-resisting building. It is absolutely not so; in fact, a great many buildings that are constructed of wood, with wooden floors, joists, and so on, are much more fire-resisting than buildings with bare iron. I think it should be made a point in all building regulations that all ironwork should be protected. Another point is the protection of lifts. Here I am somewhat at issue with Mr. Dicksee. If you have a lift running through a building and in-

Advantage of New York Practice.

closed with fire-resisting material, I do not think it is any good to seal that lift at the top. You must provide a vent; if fire occurs you want to be able to break the glass or something and get a vent for the smoke and flames; if you seal it at the top you simply drive the flames down to the different floors. What you want is a light iron roof with light glass, so that directly the flame goes up the lift it may go out at the top, and prevent the fire spreading by that means to the different floors.

Professor IRA H. WOOLSON (Columbia University, New York)—Your chairman has very urgently asked me to say something upon this paper, and I have hesitated because of a lack of intimate knowledge of the details of building construction in New York, except as to certain particular lines in which I have been interested. I join most heartily in the praise that has been given to Mr. Dicksee for his most excellent paper, which is very exhaustive, and very logically written. He has called attention to the points one by one and referred to the necessity for the alteration in the law or regulations as to each, and I think that a very admirable way of presenting a paper. I was a little surprised, however, that more stress was not laid upon the question in factory construction of sprinklers or some means of extinguishing fire automatically in case fire occurs when no one is present. In America we are very insistent upon that, and we depend very largely upon sprinklers and similar appliances of one kind or another. I think I shall be borne out in that by our friend, Mr. Hexamer, of Philadelphia, who is more familiar with such matters than I am. I did not notice whether you had any regulation with regard to the total height of buildings. With us in New York that is a very important point, and it has been a fight between the owners, who wish to build their buildings as high as they believe will be profitable, and the Building Department, having charge of the preservation of life and property, who believe we are getting too high. As you all know, we erect buildings there thirty stories high, and the tendency is to get more than twenty stories. Of course, this question does not affect you at present, but it may do so in the future, and in an exhaustive paper of this kind, with so many suggestions for legislation, perhaps that matter might have been

touched upon. With regard to the protection of iron and steel, that is a very important point, and we Americans are a little surprised that you have not faced it more seriously in the past than you have. I understand that it is very hard to bring those things about; only a sad experience will make people realize the necessity, but you will have the lesson some day as well as ourselves, and learn that iron and steel are not fireproof; that they do not protect life and property as well, perhaps, as heavily built woodwork. They may be desirable in other ways, but it cannot be said that unprotected iron and steel are fire resisting.

Mr. C. A. HEXAMER (President of the National Fire Protection Association, Philadelphia)—I have listened with very great pleasure to the paper read by Mr. Dicksee, and concur heartily in many of his conclusions. In Philadelphia we have just gone through the question of the revision of building laws. The underwriters there brought the matter to a head by increasing their rates in consequence of the erection of very high buildings of very flimsy construction. A commission was appointed to go into the matter, and I was a member of that commission. We had occasion to study the building laws of some of our larger cities in America, and drew from them such materials as we thought would be of value to us in Philadelphia. The general trend of our labors was to the following ends: First, the restriction of air limit; secondly, the restriction of height; thirdly, the protection of floor openings. Those three points were considered most essential in the construction of buildings toward the end that fires might be controlled and avoided. The new Philadelphia law, which came into effect in April, restricts the areas of unfireproof buildings to 7,500 square feet. The height of such a building is 68 feet for five stories. We recognize the slow burning construction by allowing a larger area, 15,000 square feet, and a larger height, 85 feet for six stories. Then we restrict the area of a so-called fireproof building to 25,000 square feet—I mean fireproof buildings occupied for other purposes than hotels, apartment-houses, and so on—such as warehouses and stores. We, however, have a requirement that there may be an unlimited area on the first floor only, provided the other floors are restricted in area by fireproof provisions,

Philadelphia Laws Regarding Areas and Height of Buildings.

and provided that the entire building is protected by automatic sprinklers. In St. Louis and other cities provision is made that the area of the slow burning building is increased by the introduction of automatic sprinklers. Those have been the main points, and, of course, there has been the point that Professor Woolson has referred to, namely, the protection of the metal members of the construction—not only iron but steel as well. The carrying members, the columns or girders, are frequently of steel. It is absolutely required by our law that all metal members of the construction in such buildings shall be protected by proper fireproof material. We leave it to the architect to choose such material; unfortunately, we have not arrived yet at a definite conclusion as to which is the best material. I have listened with great interest to what has been said with regard to the necessity of applying the law not only to new buildings but to buildings already existing. It is a very important point. As the gentleman truly said, while there are few new buildings going up, comparatively, there a great many old buildings that need attention. In the case of the commission I referred to, we gave up the question entirely except as to one point, and that was the protection of open elevator shafts or liftways in existing buildings. The Chief of the Bureau of Buildings may go into a building where he finds a defective elevator shaft, or one likely to produce fire, and may require that to be inclosed by a fire-resisting material, or that at each floor there should be provided trap doors, which under the law must be closed at the close of the labors of the day. Apartment-houses, hotels, schools, and hospitals all come under this law. We allow no hotel and apartment-house over four stories in height to be erected unless they are of fire-resisting material throughout. No school or hospital (I think I am correct in this, but I am not quite sure) may be over two stories high. The law is also very explicit as to theatre walls; there must be a fireproof construction behind the proscenium wall, which must be separated from the auditorium by an asbestos curtain; the law also requires that there shall be complete separation of the stage from the dressing-rooms and so on at the back. In most American cities there are either building commissions or bureaus of inspection. To those bureaus

the architects submit their plans. The bureaus usually employ competent engineers, who calculate the carrying capacity of the material employed, and only after a certificate is obtained from the Bureau of Building Inspection can the construction of the building be commenced. I want to call attention to one thing that we have in Philadelphia, and that is, so far as I know, used in Philadelphia more largely than in any other city. I refer to what is called the tower fire-escape. The tower fire-escape consists of a brick or stone inclosure extending up to and through the roof, containing a stairway which can be either of fireproof material or not, as the case may be; but the main point is that there is no interior communication between this brick tower and the building itself. There is no danger of smoke or fire in any portion of the building getting into the tower escape, and thereby cutting off the exit. The exit from the building is through a platform on the outside of the building, and from that platform by a door into the tower fire-escape. In large buildings two are required, one at each end. We consider that the tower fire-escape is most excellent for saving life, and also for saving property, inasmuch as it gives the firemen power to reach any portion of the building, and by reason of the platform on the outside of the building; and behind them the tower fire-escape gives them a fighting advantage which is not generally obtained in buildings.

Tower Fire Escape.

A hearty vote of thanks was accorded to Mr. Dicksee for his paper.

Mr. DICKSEE, in reply, said—Gentlemen, I tender you my hearty thanks for the appreciation you have shown of my paper. One or two points have been mentioned in the discussion to which I should like to refer. First of all with regard to the question of lifts. Mr. Marsland advocates the skylight over the top. Now, I have not taken the reverse view. I suggest that the wall should in all cases be carried up to the roof. I said nothing about the covering on the top of the lift. But there is also this question: In many cases these lifts do not go up to the top of the building, but only two or three stories. In those cases I think the alternative is that they must be provided with a fire-resisting floor. Professor Woolson has referred to the question

of sprinklers. I did not refer to it because there is no mention of them in our London Building Act at all. Our Building Act deals simply with the construction of the building and not with its equipment or what may be described as machinery. Sprinklers are undoubtedly very much coming to the front, but I cannot help recalling to you a case that occurred 40 years ago, in London, when Her Majesty's Theatre was burned down. That was supposed to be provided with a huge tank over the whole of the stage which should be available as an automatic sprinkler if a fire happened. The tank had got out of order and for years there had been no water in it; the water had been cut off because it leaked, and there was no water at all. That is the great difficulty in all these cases of machinery. The district surveyor has only to do with the building at the time of its erection or alteration; he has no right to go into a building to inspect at any time of the day. We have no control over the maintenance of machinery, and unless there is some supervision over these sprinklers, it seems to me that they will be found wanting when they are required. The question of the height of the buildings is dealt with in the London Building Act, but that is not a purely fire section, so that I did not refer to it. We are limited to 80 feet in height and two stories, and a room in addition. The idea of fixing 80 feet was, I think, that the highest extent to which the hose would be able to throw water would be about 100 feet; that is why it was limited in that way. In this country theatres are dealt with under special Acts. For some reason or other when the 1894 Act was remodeled out of the previous 14 Acts the Act of 1878 was still left as a separate Act. Under that, where the County Council are the authority for theatres, they have the power to make by-laws, and they have made a most comprehensive set of by-laws, to which I think no real exception can be taken except on the ground of their severity. They also have power to enter theatres erected before the passing of the Act and insist on the by-laws being carried out. The St. James's Hall, to which I refer in my paper, shows, however, that their power is limited to one operation. Mr. Hexamer also referred to the question of trap doors and lifts. I think the same objection applies here as that to which I referred in the case of

Doubts Regarding Efficacy of Sprinklers.

London Buildings Limited to 80 Feet in Height.

sprinklers. There may be a law that the trap doors should be closed, but nobody could insure their being closed at the end of each day's work. That is the difficulty we also have with regard to those party wall doors. A district surveyor may require a larger number of party wall doors in a building, and when he has left the building nobody is obliged to shut them. I am afraid that that difficulty will remain to the end of all time unless we have a daily inspection of all these places.

Mr. J. H. DYER (Vice-President of the National Fire Brigades Union)—With regard to sprinklers, Mr. Dicksee said that even if they were provided they would never be inspected, and could never be used. I can only say that on the occasion of our visit to Budapest we saw this thing in practical operation. There is an enormous tank at the top of the theatre holding 30,000 gallons. Periodically, all the fittings are taken out of the theatre, and this thing was simply let go. It was like Niagara on a small scale. It is all very well to criticise these things, but when we know that in America the Fire Insurance Companies make a difference of fifty per cent. in their rates in the case of theatres provided with sprinklers, I suppose they, at any rate, must think there is something in them.

Sprinklers in Budapest Theatres.

SECTION I.

THE PLANNING AND ARRANGEMENT OF LARGE RETAIL COMMERCIAL ESTABLISHMENTS.

By Ellis Marsland, *District Surveyor under the London Building Act.*

In considering the question of the planning and arrangement of large retail commercial establishments, there are at least four points to be taken into consideration. Firstly, the interests of the proprietor; secondly, the safety and convenience of the customer; thirdly, the local building regulations; and fourthly, the claims of the Fire Department.

Considering first the interests of the proprietor, they may be detailed as follows: Plenty of window space, plenty of floor and wall space upon which he may erect his counters and fittings, and plenty of light, preferably from the north.

The customer requires ample staircase and elevator accommodation, plenty of gangway space, and easy exit and egress.

The building regulations may require a limited amount of cubical space; therefore the building, if a large one, will have to be divided into compartments, and these shut off from one another by fire-resisting doors.

The Fire Department claims that any outbreak of fire may be quickly localized, the occupants passed to a place of safety, and that short work be made of any outbreak by reason of its being attacked from more than one point. Also that adjoining premises be not unduly endangered.

This is the problem set the architect in planning and designing a building of this character.

Much, of course, depends upon the site and its disposition, and I feel that any observations I may make would be of more practical importance were I to submit the problem

to you in a concrete form, rather than discuss it in the abstract.

I shall therefore assume a site with the not unusual accompaniment of a frontage to two streets. The site, for the purposes of this paper, will have a frontage to the respective streets of 70 feet, or 22 metres, and a depth of, say, 200 feet, or 66 metres.

It is also assumed that the building regulations limit the cubic capacity of buildings of this class to 250,000 cubic feet, as in the London regulations. This is done because I feel that dividing a building of this description into compartments is a right course, in the same way as it is considered the right principle for a vessel to be divided into watertight compartments.

It is also assumed that the fire department is efficient, and would be soon upon the scene in the event of an outbreak.

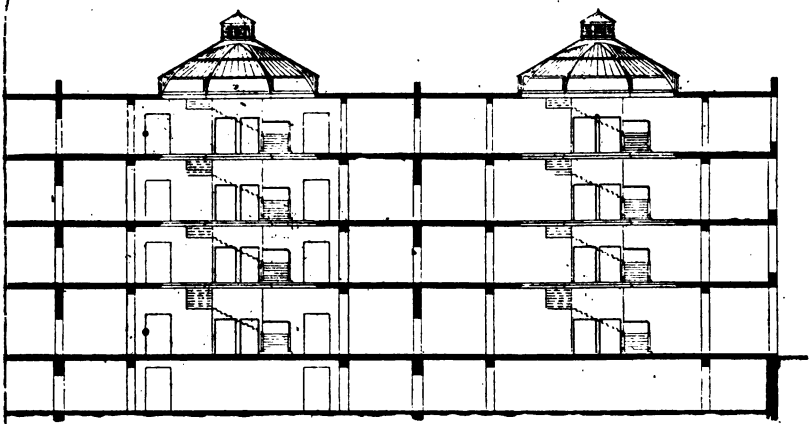
With these conditions in view, we will proceed to deal with our site, upon which I propose to place a building four stories in height, which would mean some 55 feet from the ground floor to the level of the top of the topmost story. The cubical contents of such a building would require that it be divided up into three compartments.

The plan and section shown indicate generally the attempted solution of the problem. I have, it will be seen, adopted what may be termed the *well and compartment* system, and we will proceed to determine how far it meets the requirements of the four points with which I commenced this paper.

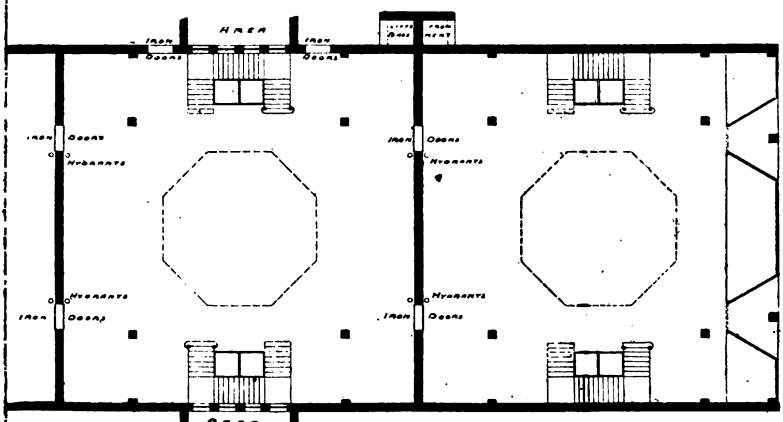
The proprietor has, I suggest, ample floor and wall space; his counters, fittings and show-cases can be disposed as he wishes, and the light is provided by means of large lantern lights from the roof, throwing a flood of light down the well on the several floors, in addition to any side lighting that, perhaps, might be available.

Means of Exit.

The customers have six ample staircases running from ground floor to roof, with an elevator provided to each. The door openings in the compartment walls are opposite



SECTION



GROUND PLAN.

RSLAND'S PAPER, "THE PLANNING AND ARRANGEMENT OF LARGE RETAIL COMMERCIAL ESTABLISHMENTS."

one another and in direct line with the exits into either street. Should an outbreak of fire occur in any compartment, the customers on each floor would pass through the doorways, and could make a safe exit in either direction.

Fire-resisting Construction.

It is necessary that all the floors and supports be of fire-resisting construction, and all iron and steel work protected by concrete or hollow tile casing. There being nothing but the contents to burn, the task of the Fire Department would be a simple one for the following reasons: That a fire on any floor could be attacked from above and below. The openings in the party walls would be a means of getting readily at the seat of the fire, and at the same time affording a chance of escape in an emergency. The well and lantern would form a shaft for the escape of smoke, and the flat roof would afford access to this from several staircases. The fire-resisting doors in the openings could with facility be closed and the fire confined to one compartment.

In a building of this class it would be necessary to provide for receipt and dispatch of goods and also for offices and staff accommodation. Any unpacking, packing or bulk store department, if situated in the basement, should not communicate with the upper part, except by lift, placed outside the building, inclosed with walls carried up through the roof and covered with a light roof of iron and glass, and the openings on each floor protected with fire-resisting doors.

Separation of Office from Main Building.

It is advisable that the offices and counting-houses be in an adjoining annex, and the dining and sleeping accommodation for the staff placed over and in this annex, with separate exit and staircase and fire-resisting floors.

The general scheme can, I think, without further explanation, be gathered from the diagram, and I invite the criticism of the meeting to my conclusions.

Discussion.

Mr. Herbert Wilmerding (Secretary of the Philadelphia Fire Underwriters' Association)—I think I can see how the plan detailed by Mr. Marsland in his valuable paper would be of great benefit where the law requires the subdivision of

the area, as it does in the United States. The total floor area for the store which he puts as an example is about 14,000 square feet. It may be of interest to gentlemen here to know that in Philadelphia we have one store which has a floor area of 100,000 square feet; that store is ten stories high. Of course, applying to a store like that the principle set out in this paper would hardly work. The question of light is, again, of great importance. In buildings of the sizes we have it would be impossible, owing to the depth and heights of the building, to get daylight entirely from the top; therefore we have largely abandoned the idea of getting daylight for the display of goods, and trust to electricity or to different prisms for throwing light in. In most of the large department stores we would do away entirely with the central light well, making the floors as fireproof as possible, so that we have the compartments horizontal, if not vertical; we are endeavoring, if possible, to get the area also vertical. I make these few observations merely to show the different conditions existing in different parts of the world.

Mr. W. H. HUNTER (Engineer of the Manchester Ship Canal)—I have necessarily had to devote a great deal of attention to the matter of fire prevention, both from the point of view of control, which we dealt with yesterday, and from the point of view of building construction; and I am just now engaged in constructing buildings which, except in one word, would come under the heading of this paper—that is, the word "retail." The buildings that I am constructing are transit sheds, which, I believe, when they are completed, will be the largest in the world. But there is one point in this paper that I would come back to—I hesitated to interpose in the discussion on the last paper with regard to this point—I thought that we had a difference of opinion between two district surveyors of London, but I was a little surprised to find, when the gentlemen who read the last paper came to reply, that that difference of opinion had disappeared. If you will allow me I will read one little paragraph in Mr. Marsland's paper upon which, with Mr.

Marsland's permission, I am going to offer a word of criticism. To tell the truth it is inexplicable to me. He says that any unpacking of goods should be carried on in the basement; that is quite right, and "should not communicate with the upper part, except by lift placed outside the building"—I entirely agree with that—"inclosed with walls carried up through the roof"—again absolutely admirable, but now comes the astonishing point—"and covered with a light roof of iron and glass." That I fail to understand. I cannot imagine how gentlemen, acquainted as these district surveyors must be with chemical principles, gentlemen having any knowledge of the chemical operation that takes place during any fire, could advocate a system of construction which would convert their lift into a funnel—into practically a draught funnel. Now there is no one here who will differ from me when I say that any process of combustion is accompanied at once with the evolution of large quantities of carbonic acid gas; secondly, that those large quantities of carbonic acid gas of themselves, if they are confined, will furnish the most efficient method of putting out fire which can be devised, better than any water system, better even than the sprinklers which have been suggested by our friends from the other side, and which I am using very largely. I should have thought that in the case of a building such as that suggested by Mr. Marsland, admirable as it is in its general outlines, in the case of the lift, the great object would have been to seal that roof. I know the difficulty about light, and about ventilation in ordinary seasons, but the great object I should have thought would have been to seal the roof to avoid any passage of air, and, therefore, to avoid the introduction of fresh oxygen, which is necessary for combustion, and to contain in that shaft all the carbonic acid gas which has been evolved. I thought for the moment that the gentleman who read the last paper held the view that I have ventured to suggest to you, but Mr. Marsland attacked that view very vigorously, and the gentleman who read the other paper appeared promptly to

Objections to Light Roof for Elevator Shaft.

abandon what I thought to be the sensible position he had adopted.

Advocates Light Roofs for Elevator Shafts.

Mr. HEXAMER—The question of the opening of the top of the elevated shaft is one that is given a great deal of attention to in our country. If it were possible to hermetically seal the entire building at the time of a fire, there is no doubt at all that the carbonic acid gas generated would soon extinguish the fire in its incipience; but the doors are there, the light well is there, and the oxygen will be provided by all those. The first thing our firemen do when they get to a building is to attempt to enter it; and if there is an accumulation of smoke the best way to enter is by opening the lift, when they can get to the seat of the fire and put it out. The breaking of the roof is an essential feature. Our building law actually provides that the roof over the stage of a theatre shall be so arranged that in the case of a fire two-thirds of the roof open automatically.

Mr. R. J. LAKE—I should like to claim, if I may, two minutes to congratulate Mr. Marsland on the practical nature of the paper he has read to us, which is not the only practical contribution he has made to the proceedings of this Congress. As a practical man myself, who is responsible for the safety of buildings and for the safety still more of the lives of those employed in the buildings, I was particularly struck by one point in Mr. Marsland's paper, namely, his placing first the claims of the proprietor. We practical men are deeply indebted to the theorists who tell us what we should do and explain the grounds on which they put forward their advice, but we unfortunately find too often that theorists may be wrong, and we have only recently at this Congress, I think, had driven home to us that the theories as to the use of iron and concrete are exploded fallacies or very nearly so. There are two points which those who are interested in this matter have to consider, (1) the protection of life, (2) the protection of property. In the protection of life no sacrifice is too great, but so long as human nature is human nature we can only minimize it; we cannot do away with or abolish fire altogether. My point

is this, that in the protection of property we should not so "protect" it that we should so reduce the value as to render the property valueless by the tax that the "protection" places upon the property. I should think it might be possible for the able men who devote their time and brains to this subject to evolve some system of mutual insurance or mutual protection which would enable us to regard with some complacency the ravages which fire must make in a crowded community. I have myself had experience of fire curtains; that is an inexpensive and also sure protection against the spread of a fire. It has often struck me that much might be done by some compulsory or partly compulsory application of fire curtains to all buildings in the course of construction, when the expense would be really almost too small for consideration. As a practical man, I hope I have not intervened unduly in the deliberations of the theorists, and I hope I shall not be misunderstood in pressing home the point that the proprietor should, as far as possible, be considered, so that in protecting his property he shall not be protected out of all the value of it.

Fire Curtains.

Lieut.-Col. Fox, F. M. G. S. (Vice-President of the N. F. B. U., chief officer of the London Salvage Corps)—I should like to add my quota of thanks to Mr. Marsland for the very nice little paper that he has found time, among his other duties, to address to us. I think that Mr. Marsland's idea of dividing up the risk as he does is an excellent one. I agree with the speaker who advocated brick and timber against stone and iron. I speak very feelingly on this stone and iron question, because it has sometimes been my lot in the interests of my employers to have to work on the two first stories of a building, the upper floors of which have been alight. If those buildings are of brick and mortar I can stop there until the fire is coming through the floor, but if they are of iron and stone and the top stories are alight I can tell you that the position is not by any means comfortable. I have in my mind a fire a little time ago, where, without the slightest warning, an iron girder came through the roof of the drill hall in which we were working. I can tell

you that an iron girder in a job like that is a very unpleasant sort of neighbor. A wall that you can see is all right, but a danger of that sort that you cannot see is calculated to funk even the stoutest heart; and, if you funk your fireman, things are very bad indeed. The provision of iron shutters I do not think has been mentioned here. I think where there are buildings of that sort in contiguity with others, iron shutters should be provided. Very often they are not used; that is the only disadvantage; but there again the question of inspection comes in. With regard to the packing departments, that is always a very great danger in these great emporiums. I do not agree that they should be at the basement. I think they should be at the top. If you put the packing department at the top of a building the smoke has got to go somewhere, and how are we to get rid of the fire. I believe very much in letting the smoke get out somewhere at any cost. I remember a fire in the basement of the Floral Hall in Covent Garden. Before we could get down to that fire I had to get on the roof with my men and break open 300 panes of glass to give the firemen breathing space. We have all had experience of the kitchens in restaurants. If the kitchen is in the basement you get the smell rising up through the house. In the same way, if the packing department is in the basement and the fire breaks out there you will get the smoke right through the place. I have only to thank Mr. Marsland for his very valuable paper.

Packing Department on Top Floor.

Mr. MARSLAND—I have only a few words to say in reply. With regard to the observations of Mr. Hunter as to lifts, I am afraid we must agree to differ. The opinion I have expressed is not only my own, but it is formed after consulting fire brigade officers. The best way to do with the lift is to acknowledge that the smoke must go out somewhere, and to aim at getting it away. My method would prevent the smoke and flame from going to other parts of the building; it all goes up the shaft, and, I think, that is the best way to get rid of it. I think if our friend will communicate with fire officers he will be inclined to change his opinion.

SECTION I.

SOME NOTES ON FIRE PREVENTION, HAVING PARTICULAR REGARD TO THEATRE SAFETY.

By A. B. Markusovsky, *2d Adjutant, Budapest City Fire Brigade.*

Extract.

Considerable attention has been given to the subject of Fire Prevention in the City of Budapesth.

The superficial area of Budapesth, exclusive of its water area, is 19,317 hectares, and among the European capitals it stands second only to the City of London as far as its area is concerned. The appended table gives some idea of the proportion of area of different capital cities.

Budapesth has 776,000 inhabitants, living in 223,000 buildings.

London has 4,536,000 inhabitants, living in about 600,000 buildings. In regard to the number of fires, however, Budapesth has proportionately very few, the annual total having varied between 350 and 500 during the last 20 years, with a maximum of 502 fires in the year 1902.

So slight an increase in the number of fires in Budapesth during the last 20 years, in spite of the rapidly increasing number of inhabitants and buildings, must be attributed to systematic fire prevention methods. Berlin commenced its systematic construction of all buildings from the fire preventive point of view in 1890. Budapesth had already commenced systematic inspections in 1883, since which time a Special Fire Commission also investigates every fire that occurs, inquiring as to its cause, extent of damage done, etc. The members of this commission also make personal inspection of all larger buildings at least once a year. Since 1895 the local regulations for buildings in

Budapesth makes it compulsory for all plans of factory buildings and theatres to be laid before the fire brigade for inspection prior to the permission to build being accorded. It has been found to be of particular value, owing to the fire brigade being able not only to advise safeguards, but also to obtain a thorough insight into the construction of various important buildings in course of erection.

Since the system of inspection came in force the Fire Commission has ordered, for the purposes of safety of life, the installation of no less than 867 new iron fire escape staircases, which are not only intended for exit purposes, but also for assisting the fire brigade in attacking a fire. It is due to the Fire Commission, too, that the number of hydrants in the City of Budapesth has been materially increased, far above the proportion of increase in other cities. Thus Budapesth has now 6,176 hydrants to work upon. To take an example of the systematic policy of fire prevention, the writer would especially point to the systematic work done for theatre protection. Special attention is called by him to the fact that, in addition to the now generally recognized systems of protection, Budapesth requires direct telegraphic communicaton between theatres and the fire brigade, the posting of a fire watch of professional firemen from the fire brigade in each theatre, and the installation of a sprinkler system over the whole of the stage. The writer then deals in detail with various requirements enforced in theatres in Budapesth, with special regard to the necessity for the immediate exit of the public from the auditorium into the corridors, and from the corridors by direct route into the street. He attaches to these exit facilities a greater importance than to questions of construction. He advocates, in the first instance, rapid exit from auditoriums and straightforward exit into the street. In the second place, he lays great stress on systematic watching and inspection of theatre buildings. In the third place, he considers it necessary to have sprinklers above the stage. Finally, he considers that the questions of construction and equipment of a building only come after the questions of exit, watching and installation of a sprinkler above the stage.

The reader handed in the following table, as per Appendix A of this paper:

Appendix A.

Table.

Capital Cities.	Area.	Hydrants.	Buildings.	Fires, 1902.	Inhabitants.
1. London (County of)	31,400ha.	27,000	616,461	3,574*	4,356,541
2. Paris	7.802	7,900	79,829	2,204	2,800,000
3. Berlin	6,342	5,390	55,023	1,934	1,900,000
4. Wien	17,812	3,276	34,484	908°	1,800,000
5. St. Petersburg	5,372	.....	.....	1,400	1,700,000
6. Budapesth	20,198	6,176	23,312	562	776,000
7. Hamburg	8,240	4,952	37,993	1,613§	740,000
8. Amsterdam	4,797	4,750	39.021	2,000	530,000
9. Madrid	6,376	.....	.....	.....	525,000
10. Munchen	8,696	3,265	21,029	263	523,000
11. Rome	1,572	.....	.....	.....	522,000
12. Kopenhagen	2,344	.....	.....	528	500,000

* Exclusive of 706 chimney fires.
° Includes 266 chimney fires.
§ Includes 478 chimney fires.

Mr. J. Sheppard supplemented this Appendix A by a further Appendix B, giving detailed particulars as to the Metropolis, as a contribution to the discussion.

Appendix B.

It may be of interest in connection with this paper to note the following facts regarding London, *i. e.*, the County of London—being the area protected by the Metropolitan Fire Brigade:

Area in Acres.

Land	73,984		
Inland water	855		
		74,839	
Tidal water	2,052		
Foreshore	627		
		2,679	
Total		*77,518	say 31,400 ha.

Population.

	Persons.
Total population, census 1901	4,536,541
The Metropolitan Police area is much larger than the County of London, and has a population of	6,581,372

Houses, Year 1901.

	No. of Houses.
Inhabited (persons sleeping on premises, census night)	571,768
In occupation, but not inhabited (lock-up offices, warehouses, etc.)	24,098
Not in occupation (to let)	15,971
Building (in course of erection)	4,624
Total	616,461

* The total of 77,518 acres should be taken for fire purposes, as the brigade attends fires in vessels on water.

These 616,461 houses contain 1,019,546 separate tenements, of which 672,030 are tenements of less than five rooms.

Fires, 1902, 3,574; excluding 706 chimney fires.

	No. of Fires.
Extinguished by persons not belonging to brigade, or by the use of bucket and hand pumps, and explosions	2,910
Extinguished by water and pressure direct from hydrant	566
Extinguished by steam engine and hydrant	98
Total	3,574

Number hydrants, 27,000.

SECTION II.

SAFETY AND CONTROL ARRANGEMENTS FOR FIRE ALARMS.

By Alexander Siemens, *Past President, Institution of Electrical Engineers.*

Whatever system of fire alarms may be adopted, the principal requirement is certainty of action, and to insure this special endeavors have been made ever since fire alarms have been adopted.

Dr. Werner Siemens recognized more than fifty years ago that the ordinary telegraph apparatus afforded a ready means for giving quick and reliable notice of an outbreak of fire, and he devised a system which has since been widely adopted and developed, as the difficulties of the service were more fully recognized during the working of the various apparatus.

A description of this system will serve for explaining the dangers and interruptions to which fire alarms are exposed, and will also detail the safety and control arrangements by which the safe working of the system is assured.

The alarm stations which are to signal to the nearest fire station are grouped in various circuits, each of which includes a Morse recording instrument at the fire station.

It is immaterial how many alarm stations are inserted in one circuit, as each alarm is furnished with a clockwork, which, when started, sends automatically certain prearranged Morse signals indicating the particular alarm station at which help is required.

In addition to their automatic sender a telephone or a Morse key can be added at an alarm station, if its situation makes it desirable to have these additional means of communication to the fire station.

For the purposes of control it is preferable to have a constant

current flowing through each circuit, and to employ metallic circuits without any earth connection.

Diagram No. 1 shows the connections of such a circuit. A1, A2, A3, etc., are fire alarms. " T " is a wheel, set in motion by the clockwork when the alarm is given, and fitted with differently shaped projections in each alarm.

These projections break and make the circuit when the wheel turns, and thus produce signals in " M," the Morse instrument at the fire station, with which an electric bell is connected, which rings when the current of the circuit ceases to be constant.

The causes which endanger the correct working of this system may be divided into two classes: The first comprises interruption of the lines, such as faults, earth connections or breaking of the conductor, and the second, disturbances of the apparatus, in which class the simultaneous sending of alarm signals from two stations may be included.

Working the system with a constant current assures the prompt indication of any total interruption of the circuit, as the indicator included in the circuit would fall back to zero, and the electrical bell begin to sound. Each fire alarm can be connected to earth by a contact plug, and whenever the fire station finds that the line is interrupted, inspectors are sent out who test the continuity of the line by connecting one apparatus after the other to earth, and in this way the position of the break of the line will be ascertained. Then the two alarms next to the break are connected to earth until the line is repaired. In this way the circuit will still be available for giving alarms during the repair.

Against faults and accidental earth the safety devices consist of very accurate measuring instruments, and for this purpose each circuit has inserted in it a milli ampere meter, which indicates accurately the current flowing at any time; usually 35 milli amperes is the correct current for such a circuit, and the indication of the instruments will gradually go down as the battery becomes exhausted. If, however, the indication of current varies rapidly or increases, it must be due to either a fault or earth, and the inspector should at once go round the circuit in order to remedy the fault or the earth.

In a fire station from which a number of circuits go out,

another measuring instrument is connected to all of them in the way indicated in Diagram No. 2. Each of the circuits C1, C2, C3, etc., is connected to a terminal resting on a metallic disc S, which in its turn is connected to the measuring instrument, a relay and to earth.

As long as no earth exists in any of the circuits the measuring instrument will show no current, and if only a small leakage exists the current through the measuring instrument will not be strong enough to actuate the relay, but if in any one of the circuits a fault exists large enough to cause a current which can actuate the relay, a bell will sound and the attendant will know that he is to locate the fault which causes the bell to ring. For this purpose the disc S has one insulated segment which can be brought under the terminal of all the circuits in turn. The attendant revolves this disc, therefore, until the bell ceases to ring, and then he knows that the circuit, the terminal of which rests on the insulated segment, contains the fault. For the sake of convenience the disc shows the number of the circuit through a little window of the case in which it is contained, and then the attendant has to inspect the circuit in question in order to remove the fault.

When a fault has been detected in this way its exact location can be determined by measuring the electrical resistance of the conductor, from the fire station to the fault. For this purpose special instruments are provided in the fire station to enable the attendant to make the necessary measurements, although he may not be a skilled electrician. The measuring apparatus consists of a small galvanometer capable of indicating currents in either direction, which forms part of a Wheatstone Bridge. This consists of a measuring wire stretched on a slate with a contact sliding on it and branch resistances. A disc marked with a scale giving the readings directly in ohms is firmly connected with the sliding contact and is moved by a handle from outside. Close to the handle is a contact key for the galvanometer, and by the side of it is a small switch for the variation of the branch resistances. Diagram 3 shows the connections and requires no further explanation. In addition to these instruments two commutators are necessary so that each end

of each circuit can be connected to the measuring instruments. When a measurement is to be made by these instruments the commutators are first placed in their proper position, the branch resistance is adjusted, and while pressing down the contact key in the galvanometer circuit the handle shifting the position of the contact sliding on the measuring wire is turned to the right or left until the galvanometer needle points to zero. Then the value of the resistance in ohms will appear before a little window provided in the case. As the resistance of the conductor per unit length is known, the distance of the fault can be calculated. In this way all interruptions caused by faults occurring in the conductors can be detected and remedied.

It remains to indicate the arrangements by which the safe working of the apparatus is insured. Each fire alarm consists of clockwork with weights or spring drive. To prevent simultaneous sending of signals from two such alarms, while insuring that the second alarm is sent on to the fire station after the first alarm has been completed, an electro-magnet is added to each fire alarm, which prevents its function when no current or an intermittent current passes through the line. The clockwork is thereby prevented from running down as long as there is a total interruption of current, or while another fire alarm is sending its series of currents to the station. By this arrangement it is therefore impossible that a clockwork could be started and run down without the signals being received at the fire station. But when the line is repaired, or when the first signal has been completed, the second alarm signal is sent on and is recorded on the Morse instrument of the fire station.

If overhead conductors are used in the circuit it is naturally necessary to prevent damage to the apparatus from lightning, or from all high tension currents which might enter the circuit through breaking of trolley lines or otherwise. These contacts with high tension currents are particularly dangerous when metallic fire alarm circuits without earthing connections are employed.

When telephones or other small apparatus are connected to the fire alarms all these apparatus are out of the circuit when not actually in use, and it is sufficient to place in each fire alarm

an ordinary lightning conductor with points, but at the fire station, where the Morse apparatus and the measuring instrument have to be permanently in circuit, special arrangements have to be made to protect these apparatus.

The safety devices which have to be inserted at each end of each circuit are illustrated in Diagram No. 4, and consist essentially of three separate apparatus. In the centre is a lightning discharger, consisting of two carbon plates placed very close to each other in a vacuum, the one connected to the circuit and the other to the earth, and it will act with about 300 volts. Between this lightning discharger and the line is a safety fuse, which will not explode with 500 volts, and will interrupt the circuit when the current exceeds 4 amperes. As such large currents might still damage the instruments at the fire station, a further fuse is inserted between the lightning discharger and the instruments, which does not allow any current to pass which could damage the instruments. All these fuses and lightning dischargers are so arranged that they can be easily exchanged without the attendants being obliged to touch any live parts.

The advantages which are secured in this system may be summarized in a few words:

(1) Positive and permanent indication at the fire station as long as the circuits are in proper working order.

(2) Immediate signal by a bell if anything unusual occurs in any one of the circuits.

(3) Ready means to determine in which circuit a breakdown has occurred.

(4) Simple measuring instruments to locate a fault.

(5) A fault or even the total rupture of the circuit does not interfere with the proper function of the apparatus during repairs, after the line has been connected to earth on both sides of the fault.

(6) Non-interference of several alarms given simultaneously, as the instruments will automatically wait for each other and then send their signals to the fire station, where they are recorded.

(7) Ample protection against stray currents.

(8) Great saving of conductors as compared with systems

where each alarm requires a separate connection with the fire station.

Although the apparatus have been described in connection with one particular system, it is obvious that most of them can be advantageously employed with any system using electric currents to convey the alarm to the fire station.

Discussion.

Mr. Gavey (the Engineer-in-Chief of the General Post-office) opened the discussion—Sir, the public fire alarm systems may broadly be divided into two classes: one, in which each fire alarm post is connected by a direct and independent wire to the fire station; and the other, in which a number of posts are connected on one circuit in a manner broadly indicated by Mr. Siemens' paper. The question as to which system should be adopted would very much be a question of expense in many cases, and an engineer who had to devise a system would have to consider whether the expense of a large number of wires was greater than that of a system such as that described, or whether the advantages of one were greater than the advantages of the other. In this country, I think, generally speaking, one circuit per fire alarm post has been generally adopted, and I am very sorry that we have in this section no representative of the institutions in this country who is prepared to give a description of the systems generally in use in the United Kingdom. One advantage of the British methods is that a broken wire only interferes with one alarm where a separate circuit exists for each alarm post. I had the pleasure of carefully examining the system devised by Siemens Brothers at the Earl's Court Exhibition, and I was very much struck with the thoroughness and the attention to detail—which, by the way, is characteristic of Messrs. Siemens' house—and the perfection with which everything had been worked out. Every difficulty seems to have been foreseen, and, as pointed out by the lecturer, an ordinary fault on one wire should cause no interruption to the general section—at any rate, any interruption that may arise need only be

of a very brief duration. Of course, a fault on two wires of a circuit must necessarily cut off a certain number of the stations, the number being dependent on the position of the fault itself. I think it would be interesting to know if Mr. Siemens could give us any information of the practical result of the working of the system in those towns in which it has been applied. As I said before, as far as I could see in the course of half an hour's investigation, everything possible had been foreseen; still, there are occasionally unforeseen circumstances that arise in connection with every electrical device, and I think if Mr. Siemens could give us a little information as to the result of the working it would be of very great interest to the meeting.

Mr. C. MAY—I have had nineteen years' experience with the apparatus as described in the city of Dunedin, New Zealand, and during the nineteen years that I had charge of that installation I have never known of one failure. We, of course, have had false alarms, and so on, but I have never known a failure when there has been a legitimate call. We had in each box, visible to the passers-by and the police, a small indicator to show whether that box was out of circuit or not; if he saw a red disc, that informed the passer-by that that box was out of circuit. In many cases that had been the means of a report being sent in by the police or the public to the fire station. We had not those at first, but we had them fitted to each box. It was an installation with one wire round the city and about 42 boxes. We had, of course, the means for localizing faults, and an apparatus for testing the resistance of the line, which, of course, was known if any variation was recorded, but the safeguard of the system was this signalling disc in the box for passers-by to observe. I could not tell you the number of times the boxes have been reported out of order from the man in the street, but I know it was a considerable number. I may say that I had the pleasure of being trained at Messrs. Siemens' Brothers, from 15 till I was 23, when they kindly recommended me to go to New Zealand, and it was there, on arriving in the city of Dunedin, that I was made honorary electrician, and had the looking after of this system.

Mr. BUGLER (Bremen)—Mr. Siemens' system is going to

be employed in Dresden, Bremen, and Charlottenburg. That is the outcome of the Fire Exhibition in Berlin, in 1901. The three towns mentioned have not completely finished their installation, but they will shortly do so.

Mr. SIEMENS—Mr. Gavey has really said everything about this system that I could add. I mean it is perfectly correct as he puts it, that if one fault occurs you can eliminate it as I have shown; but if two faults occur, before the first appears, then a certain number of the alarm stations are out of circuit. And I was very much pleased to hear from Mr. May that he has had such good experience with this apparatus, and I am very much interested especially in that additional safety arrangement which he described, that each box indicates whether it is in circuit or not to the passer-by, and that the passers-by in New Zealand are so public-spirited that they tell any station if the box appears to be out of order. Attention was called to the fact that this particular safety arrangement which I have described has only been lately put into use in a few circuits, and, as Mr. Dittmann has told us, it is also being put up in Bremen, Dresden and Charlottenburg, and that it was really the outcome of the Fire Exhibition at Berlin three years ago. The principle of the system is over fifty years old, and, as Mr. May told us, it has always been employed in New Zealand, and has been at work there for nineteen years already; but the safety arrangement there is new, and has been added in accordance with the experience gained in the discussion which took place during the Fire Congress at Berlin, and it has now only just been put up.

SECTION II.

THE NECESSITY FOR AUTOMATIC FIRE ALARM SYSTEMS.

By G. H. Oatway, *of Glasgow.*

Extract.

Whilst his subject confined him to the consideration of automatic appliances—that is to say, those which were independent of human initiative, but which detected and announced the presence of danger automatically—as opposed to street fire alarms, hospital, asylum or factory pushes, etc., which simply provided means for communication when someone had discovered the fire, it would be necessary, stated Mr. Oatway, that an intelligent consideration should be given to the two, and that the functions and limitations of each should be understood. Both were useful, and both had done good work. But whilst the latter might be said to be a tireless creation of nerves and brain and energy, self-contained, lifeless, mute, incapable of doing anything off its own bat, perishable without protest with the building it was wrongly assumed to protect, and as useless for the purposes of alarm as the rope which led to the belfry if there was no hand to use it, the whole of its shortcomings had been provided for by the former, and there was nothing possible with the non-automatic device which was not done with equal certainty and reliability by the automatic system, provided it was designed upon correct lines. The reformer who aimed at reducing fire waste must turn his attention, primarily, to hastening the alarm. The crux of the matter was, not what quantity of gear it took to deal with huge conflagrations, but how to concentrate at the earliest stage upon the outbreaks as they occur, and to check them before they had grown beyond control.

Mr. SEGUNDO opened the discussion on Mr. Oatway's paper:

Mr. CHAIRMAN AND GENTLEMEN—I am sure we are all agreed that the subject upon which Mr. Oatway has just held forth is one of immense importance, and undoubtedly the fire losses in this as well as in any other country would be greatly diminished if the means of communication with the fire brigade or the means of applying the apparatus which might be existing for the purpose of extinguishing a fire was called into operation at an earlier period after the fire was discovered. We must take the expression of "fire prevention" in the broad sense of the word. This Congress is a conference in which we propose to discuss all means of preventing fire. When you come to think of it, that is not the way it is put. What we are really doing is to facilitate the means of preventing the spread of fire, because if you talk about the prevention of fire you confine your remarks at once, of course, to the building construction and to other means of rendering buildings fireproof. But what we are chiefly concerned with, as we have here representatives of so many continental and colonial fire brigades, is the question of efficiency and prevention of fire, and in that connection I hope the chairman will allow me to make some remarks upon what I consider to be one of the greatest of lost opportunities of the City of London. Statistics show that although the cost per head of population of our fire brigade in London is about double that in Dublin, Manchester, Liverpool, or Glasgow, still the fire loss per head of population is also about double, instead of, as we might easily be led to hope, one half. I think everyone will admit without the least hesitation that the fault cannot lie with our men. (Hear, hear.) There can only be one opinion on this question. Our firemen are as brave and as self-sacrificing as any other firemen in the world, and their devotion to duty is second to none; therefore the reason is not to be sought in this direction. I venture to think that it is to be sought in the direction of the quickness and speed with which extinguishing apparatus can be brought to bear after

High Cost and Low Efficiency of London Fire Brigades.

a fire has been discovered. Mr. Lépine, in his remarks at the opening of the Congress, quoted a French saying respecting the value of water at the beginning of a fire, which is extremely apt. He said, in the first second you require a glass of water; in the second second a pail of water; and in the third second a barrel of water, and he emphasized the remarks of this Congress from the point of view of attacking an incipient fire at the glass of water stage. Now all experienced firemen will tell you that when a building has got well alight it is hopeless to attempt to extinguish it, and one's efforts can only be directed toward the preventing of it spreading to the neighboring buildings. Immediately the outbreak is discovered you want to be on the spot with your appliances, and in that connection I beg to draw attention to the facilities which could easily be applied in the City of London, if only the authorities and powers that be would take advantage of the opportunities offered to them —I refer particularly to the 130 miles of high pressure water-mains which are now laid throughout London by the Hydraulic Power Company. It was shown 23 years ago, in a paper by Mr. Greathead, that the injector hydrant operated by a small jet of high pressure water, inducing a low pressure current from the ordinary main was as useful and as efficient as the steam fire-engine in dealing with fire. Imagine what an immense advantage would be derived by the installation of such injector hydrants at suitable points in the main thoroughfares of London. Immediately on the outbreak of a fire a policeman or any other unauthorized person could immediately bring this hydrant to work, and perhaps in nine cases out of ten avoid a serious fire, a serious loss, and, what is more important, loss of life. The pressure required to throw a jet about 80 feet from a one-inch nozzle at the end of a hose 400 feet long may be calculated at 85 lb. per square inch. The pressure obtained by Manchester, Dublin and Liverpool, whose water supply is obtained by gravitation, is, roughly, 60 or 70 and sometimes 80 lb. per square inch. In London, the result of tests made by the late Metropolitan Board of Works has shown that

London Water Pressure.

the average pressure is seldom higher than 30 lb. per square inch, which is useless in circumstances which need a jet to be thrown 80 feet high. There the London Hydraulic supply comes to the rescue, and by means of these injector hydrants coupled on to the mains, and with their suction or reduction pipe simply attached to the low-pressure main, you would immediately have a source from which you would draw all the water you wanted, because we are not in any way stinted as regards water. We have not, I am sorry to say, the co-operation of the London County Council. It is a thing which is very much to be regretted, and I think that perhaps the happy way in which the Lord Mayor of London spoke on behalf of the Corporation of London on the value and importance of this Congress, is the best rebuke that could have been administered to the London County Council for their apathy in regard to this matter.

Criticism of County Council.

Sir JOHN COCKBURN (Australia)—I have simply got up for the purpose of asking if there is any representative from the United States who can tell us what position in the treatment of fires the automatic fire alarm now holds in the United States. I think that would be of great advantage to the members of this Congress.

Mr. PURCELL—As the question put by the last speaker does not seem to be answered by any gentleman, I thought I might say a few words with regard to the adoption of automatic alarms in America. I visited the States on two occasions, mainly in connection with the question of fire protection, and I was afforded very liberal facilities for studying the means they have adopted there: in the first instance, in getting the alarm, and in the second instance, in getting quickly to the fire; and I could not help noticing that in all the principal fire stations in the big cities they had a very fine installation of automatic fire alarms coming from the main streets into the fire stations. In some instances those were under the control of an officer belonging to the department; in other instances they were controlled by the companies who installed them, such companies having their own men on the premises of the fire department to see that

Use of Automatic Alarms in U.S.

these instruments and indicators were in perfect working order, and that no hitch arose in the proper transmission of the alarm. Seeing all that, I did not, of course, enter into the exact means that were used for transmitting the alarms, but they were all automatic. There were various means used by various companies, but they all tended to the same purpose, and that was to give an automatic signal to the fire department that a fire had broken out in a particular building. They have special sections dealing with the automatic fire alarms, and these special sections indicate, first, where the alarms come from, next, the extent of the risk, and next, the extent of the appliances and men that are to respond; so that every member of the department knows exactly all about this—the buildings they control, and they know what they have to meet when they are going there.

SECTION II.

ELECTRIC WIRING AND FIRE RISKS.

By E. C. de Segundo, *A. M. Inst. C. E.*

Extract.

Experience has shown that a building lighted by electricity enjoys complete immunity from risk of fire, provided always that the erection of the wires and fittings has been carried out in a sound, workmanlike manner, but that the keen competition among electric wiring firms, owing to the short-sighted policy of the owners of buildings who are apt to think more of first cost than of possible subsequent outlays, has acted as a powerful stimulant to "jerry" wiring.

Pleads for Higher Standard than now Allowed.

My experience for some 15 years past has lain to a great extent in electrical matters, and I have made a study of the subject of electric wiring systems, and from the point of view of "Fire Prevention" I plead for even a higher standard than that which would satisfy the fire insurance companies' surveyors.

The essential condition of a properly erected wiring installation consists in providing that the electric current be kept within its prescribed bounds, and that if, by any unforeseen contingency, a way should be opened for the current to travel in any unauthorized direction, the supply should be cut off automatically and instantly. No absolutely reliable means have as yet been decised whereby possible trouble due to electricity "out of bounds" can be guarded against.

Conducting Wires.

The conducting wires should in all cases be copper having not less than the standard conductivity of 98 per cent. of chemically pure copper, and the size of the mains, sub-

mains, and distributing branch circuit should be calculated to carry the maximum current under normal conditions without any perceptible increase in temperature. With reference to the determination of the allowable rise in temperature of a conductor, I think the following definition is a practical one: "By safety is meant that there shall be no perceptible heating of the conductors to the touch."

The standard of 1,000 units of current per square inch of sectional area of copper has been adopted as a safe one, provided the maximum current does not exceed 100 amperes, but to secure efficiency as well as safety it is necessary that this factor be controlled by a further provision that in no case is the drop in pressure from the root of any circuit to the extreme end thereof to exceed 2 per cent. of the pressure at the root. So far we provide against over-heating of the conductor and against inefficient incandescence of the lamp, or unsatisfactory working of arc lamp or motor fed by any of the circuits as long as the current does not exceed that corresponding to full normal load. It is absolutely essential, however, to provide for such unforeseen contingencies as contact between wires of opposite polarity, or against a flow of current largely exceeding the normal from whatever cause this might arise. To effect this, means are adopted analogous to the fusible plug which one has heard of in connection with steam boilers, and wherever a change of section of the conductor takes place a piece of specially made fusible wire should be introduced between the main conductors and the corresponding branch wires, this fusible wire being of such a size that it will melt and thus automatically cut off the current supply before the latter becomes large enough in amount to seriously raise the temperature of the conducting wires in the branch circuit, or otherwise to set up a risk of fire.

Fuses not always Reliable.

This principle should be adhered to most strictly, and constitutes, if properly applied, a not inefficient safeguard against fire due to over-heating of conductors. Too much reliance, however, must not be placed upon fuses or cut-outs for the following reasons. It is impossible to define the vol-

ume of current which does, or does not, constitute a risk of fire. In some cases a considerable current may leak across from one wire to the other, or away to earth, without causing any serious heating effect, whereas in other cases a leakage of current of an inappreciable amount has caused a fire. It depends entirely upon circumstances, upon the nature of the path by which the current passes, or, in some instances, one of which I am about to quote, upon circumstances which are entirely obscure. For instance, I have seen a lamp-holder (which held a 16 c.p. lamp) with cylindrical portion burnt right through and the contact plungers fused to the sides of the holder, but the 5 ampere fuse which protected this lamp circuit did not blow. What is even more extraordinary is that the heating was quite local. The flexible wires were not injured nor was the lacquer on the screwed cap of the holder affected.

The protection afforded by fuses, therefore, is at the best of a relative character. A concrete example may, perhaps, make this more plain. Imagine a circuit entering a building from the company's supply main and conveying current to a large chandelier which would require say 20 amperes. The fuse on this circuit would be designed to melt when the volume of current reached say 30 amperes. It is therefore clear that should any accidental partial contact between these mains take place, 20 amperes could pass from one to the other and constitute a very grave fire risk without affecting the fuse, because a fuse cannot act intelligently and differentiate between 20 amperes going where it ought *not* to go and 20 amperes performing the legitimate work of supplying the chandelier. If on the other hand this amount of electrical energy had been distributed over a number of lamps on different circuits, it is quite clear that by judicious sub-division of the circuits feeding these lamps, the size of the fuses could at a very early period of the sub-division be reduced to such dimensions that the irresponsible action of say three to four amperes in any circuit would be sufficient to blow the fuse.

For safety against risk of fire one must depend entirely

Safety Depends upon Insulation.

upon the means adopted for keeping the electric current within its designed sphere of action, namely, the character of the insulation of the wires or of the means adopted to prevent contact between wires of opposite polarity. This includes:

(i.) The insulation on the wire.

(ii.) The means adopted to guard against mechanical injury and damp.

For such wires as we are dealing with, the material hitherto used as insulation has been mostly rubber, but to those having any knowledge of the rubber trade the expression "rubber insulation" covers a very wide field indeed. Some so-called rubber insulation taken from electric cables has been found to contain less than 20 per cent. of rubber, the remainder being adulterants and pigments of all sorts and kinds, but which in a number of instances are found to exert a deleterious influence upon the character of the rubber mixture as an electric insulator. Up to the present nothing has been found to touch best quality rubber specially prepared to resist the oxidizing action of the atmosphere, and the deleterious influence of any rise in temperature of the conductor.

Damp.

Damp is most insidious in its action, and every effort should be exerted and every means adopted to safeguard the installation from its evil effects.

Acid Dampness.

Damp may arise from a variety of causes. In the case of a new building the moisture is often of an acid nature which, even when present to so small an extent as to be inappreciable by those living in the house, may entirely undermine the wiring installation in six months. I have in my mind a case where the wiring was carried out by a thoroughly responsible firm of contractors for a customer who did not stint them as to price. Inside of six months the insulation test showed a remarkable degree of deterioration, and an examination revealed the fact that the insulation on the wires had become quite rotten, and that in several places

electrolytic action had so seriously diminished the sectional area of the conductor as to render the fuses absolutely useless as a means of protection from overheating of the conductors. To show how apparently slight was the extent of the damp, I may mention that in one room which was papered with a paper of a delicate pink hue, no sign whatever of damp was noticeable, and the tenants of the house had never felt or discovered any evidence of damp, yet in this room a switch was absolutely corroded up, and copper carbonate had come through the holes in the base from the conducting wires and collected in considerable quantity on the bottom of the base.

This is by no means an isolated instance. Competent and intelligent supervision of the work is indispensable.

Were it possible I should like to see every wire in a house treated as if it were a submarine cable. Unfortunately, however, gutta percha (though the insulator par excellence of a cable which is to be immersed in water and protected from the action of light and air) is useless for the wiring of houses: Firstly, on account of its extreme sensitiveness to the oxidizing action of the atmosphere and to the action of moisture and light; and secondly, because its softness and plasticity at a temperature only slightly elevated above normal renders it unsuitable mechanically. It is possible, however, that before long a new form of insulator may be introduced upon the English market, which, while possessing all the useful properties of gutta percha, is practically indifferent to the action of light and air, and is very much harder than gutta percha. Large quantities of wires insulated with this material have already been used on the Continent with excellent results.

II.—Mechanical Protection.

For mechanical protection various materials are superimposed onto the rubber covering according to the exigencies of the case. For electric lighting of buildings, however, it has been found more convenient to use the wires containing

comparatively slight mechanical protection and to run them through tubes, or in the familiar wooden casing, whereby the risk of accidental injury is reduced to a minimum if properly carried out. The ideal method of wiring a building, to my mind, is to use nothing but the highest class vulcanized or other suitable rubber insulation, with some suitable form of mechanical protection in the way of braiding merely to protect the wire from injury during its passage from the factory to the place at which it is to be erected, and to inclose the wires in a continuous system of cold drawn steel tubes specially selected for smoothness of bore, with joint boxes inserted at all points necessary to enable the drawing in of the wires to be carried out without injury to their protective covering and to facilitate inspection, withdrawal of any wires for the purpose, if need be, of increasing their size, etc., the whole system of steel tube and joint boxes being connected to earth. Such systems have been worked out in almost perfect detail by many firms making a specialty of this class of work, and when properly installed constitutes the best means within my knowledge of securing immunity from fire due to electrical causes. Unfortunately, however, these systems have the disadvantage of being somewhat expensive. But while there are millions of lights successfully and efficiently fed by wires protected by wood casing, and while I have instances in my mind of such installations as good to-day as they were 12 years ago, still, when dealing with this matter from the point of view of fire protection, there is no doubt in my mind that the system I have described is the best and safest; and the difference in cost is not so serious as appears at first sight; in the case of a large building for the wiring of which I recently had to draw up a specification, I went into the question of alternative schemes of wood casing and steel tubing. The cost on the tube system was certainly not more than 25 per cent. greater.

Discussion.

Mr. Frank Broadbent (London), in opening the discussion, said: There is, of course, nothing which we want to take

exception to, but I will say a few words upon the fires that I have known caused by wiring. Iron piping work badly carried out is worse than wood-casing work. I have known fires caused through the thinning of the copper wires near the joints in damp places, also through the short circuit of double pole fuses, more particularly when such fuses are inclosed in iron boxes. Then there is a danger arising from double pole fuses. In the old days it was the custom to put a fuse on one pole only, but now it is compulsory to put fuses on each pole. In the event of leakage on two separate branches, if the positive fuse on one and the negative fuse on the other blow, we still have two live wires left in which the fuses are too small to protect the leakage current. If it could be arranged that the positive fuses were smaller than the negative, so insuring their blowing first, we should have a greater element of safety. Then we have the danger of installations on supply mains, in which one main is earthed. I have known a fire in the City caused on an installation simply by the over-heating of the earthing wires joining the iron switch and fuse to the metal pipes in the house. Fires also I have known have been caused by the falling of a telephone wire across a trolley wire, and so allowing the current to pass into a house and set fire to the telephone box.

Mr. A. LESTER TAYLOR—Speaking as the electrical engineer of two of the most important English fire offices, I should like to say that, in my opinion, a stout steel tubing affords the very best means of protecting the conductors, and that the system laid down in our town has been quite successful in practice. We have found where a steel tube near a gas pipe leads to the gas pipe that it ignited the gas. That has been the principal fault, but apart from that, as a system, it is undoubtedly the best one. We have heard that in America fires have been attributed to electricity, but that of $12,000,000 of property insured in the Mutual Associations there has not been a single electrical loss. That is not because the manufacturers are mutually associated, but because the outcome of their system is that if one of the

insured would not carry out reasonable suggessions then he would have to go outside those particular organizations. The ordinary fire offices here in commercial competition cannot insist on anything like that protection. They would not get the business.

Mr. L. J. LANGRIDGE (Leytonstone)—I should like to say one word in favor of the use of steel tubing. In my experience it is one of the finest systems you could have for electrical installation. I could tell you of fires caused by wood casing not a quarter of a mile from here. In the pipe system it must be arranged so that the condensed moisture can be drawn off.

A DELEGATE—From the fireman's point of view I think the great want is a more effectual superintendence of the installations. We have sanitary inspectors to see that sanitary work is done properly. We want electrical inspectors appointed by the municipalities to see that electrical installations are right. In connection with this metal tubing I have known installations in steel tubing where the rough ends of the tubing have been left exposed. The very slightest movement of the wires causes friction and sets up extreme danger, and I think that shows the necessity for some inspection by a recognized authority.

SECTION III.

THE STORAGE OF EXPLOSIVES, PETROLEUM AND CERTAIN CHEMICALS IN DENSELY INHABITED AREAS.

By Captain Thompson, *H. M. Chief Inspector of Explosives, London.*

At first sight it would appear to be better in the interest of public safety to prohibit altogether the keeping of explosives in populous places; but in every civilized community it is necessary to balance the requirements of personal safety against those of important trades. For this reason limited amounts of explosive are allowed to be kept even in the midst of cities in this country, and in most other countries of the world.

Two Methods for Storing of Explosives.

For purpose of sale there are two methods in which explosives may be legally kept in populous areas. These are technically known as modes A and B. A trader may keep in either or both of these modes, provided that he takes certain precautions, and that he registers his premises, or, in other words, that he informs the local authority of his intention to keep explosive. The officer of the local authority then has power to enter the premises and see that the legal precautions are taken and that the trader does not keep more than the law allows. Under mode A the explosive is to be kept in a building or fireproof safe detached from a dwelling house and at a safe distance from any public place or thoroughfare. In most cases, persons who wish to keep under this mode erect a small brick building in a back yard or garden. It is obvious that explosive kept in a detached building is safer than when kept in a shop or dwelling-house, and for this reason the law allows a larger quantity in the former case. However, there is not always a back yard or garden available, and where this is the case the trader has to fall back on mode B, which consists in a substantial receptacle

Amounts of Gun Powder and Dynamite.

inside his house or shop. He can then only keep one-quarter of the amount allowed for mode A. The actual quantities which may be kept are, in the case of gunpowder, smokeless powder for small arms or fireworks, 200 pounds under mode A and 50 pounds under mode B. In the case of dynamite or other blasting explosive, or where gunpowder and fireworks are kept on the same premises, the quantities are 60 pounds under mode A and 15 pounds under mode B. Fortunately the requirements of trade seldom render it necessary to keep blasting explosives in populous places.

It will be seen that the quantities which are allowed to be kept are sufficient to do a large amount of damage in the event of explosion, and therefore the importance of taking the most stringent precautions to prevent the explosive from being ignited cannot be over-estimated. I regret to say that I have had several opportunities of witnessing the amount of damage and personal injury which may be caused by neglect of precautions in keeping explosive on registered premises. I might instance a case where from neglect of one of the most important regulations about 30 pounds of black and smokeless powder exploded in a gunmaker's shop, with the result that the stone front of the building was thrown into the street, killing and injuring several persons.

Effect of Explosion of 30 lbs. of Gun Powder.

I will now deal with the precautions enjoined by law, and with others which appear to me desirable. In the first place, the receptacle in which the explosive is kept must be exclusively appropriated to such keeping, and must be kept locked so as to prevent mischievous or inexperienced persons from access to the explosive. The interior of the receptacle must be free from grit or exposed iron, and must be kept clean and free from spilt explosive. As to the best form of receptacle, there may be some difference of opinion. The ordinary japanned tin trunk is frequently used for keeping explosive under mode B, and, in my opinion, this is a very good form of receptacle, especially for fireworks. Sometimes a strong wooden box is used, whilst some traders prefer to fit up a cupboard or drawer for the purpose. This latter method has the disadvantage that it is not so easy to remove the explosive in case of a fire. Gunpowder or smoke-

Kind of Storage Receptacle.

less powder may be kept in a fireproof safe, but the law no longer gives any advantage in respect of quantity to the trader who uses this form of receptacle, with the exception of those who register their premises for the keeping of gunpowder only, and who may still keep 100 pounds in a fireproof safe under mode B. This privilege has been taken away by an alteration of the law in regard to premises registered for explosives other than gunpowder, the reason being that the advantage of a fireproof safe for the keeping of explosives is regarded as more doubtful than it was when the Explosive Act was passed. At that time experiments were made by subjecting safes containing small quantities of gunpowder to the heat of an actual conflagration. The results were satisfactory in the highest degree, and there is no doubt that a well-constructed fireproof safe, under normal conditions, does offer good protection to its contents against destruction by fire. Nevertheless, on two occasions well-made fireproof safes have failed to prevent an explosion. The first of these accidents occurred during a fire at a gunmaker's shop, and there is little doubt that the failure of the safe was due to its having fallen from the top of the building and being broken by the fall. The cause of the second accident was, however, much more doubtful. In this instance a fireproof safe by one of the best makers, which was locked and bolted, and which contained nothing but gunpowder, exploded, killing the only man in the vicinity. There was evidence that the rule as to cleanliness of the interior had been neglected, and that gunpowder had been spilt, not only in the safe, but also on the stone floor outside. The only theory which I could form as to the cause of this accident was that the powder spilt on the floor had been ignited, probably by the fall of a steel implement, and that the flash had been communicated to the interior of the safe by means of powder grains crushed in the flange of the door. When an explosion does occur in a safe its effects are liable to be more disastrous than if the explosive is contained in a less substantial receptacle. Another disadvantage of the use of a safe for explosive is that, owing to its great weight, it cannot readily be removed in case of fire. This brings me to the consideration of the best position within a building for the keeping of ex-

Objections to Fireproof Safes.

plosive. The only regulation on the subject is to the effect that the explosive may not be kept in dangerous proximity to articles liable to cause fire or of a highly inflammable nature. Among traders there is considerable difference of opinion as to the safest position in which to keep their explosive. Some prefer to place it at the extreme top of the house, and there is a good deal to be said for this practice. At the top of a building an explosion would generally be less disastrous to life and property than one on the ground floor. Again, when placed in a top room the explosive will be less accessible to unauthorized persons, and will be freer from certain dangers of ignition to which it might be exposed in a part of the building which is much frequented. On the other hand, explosive at the top of a building is more difficult to remove and more likely to be involved in the case of a fire in the building. Again, the keeping of the explosive in an attic often involves the use of a naked light if the receptacle has to be opened after dark, and this may involve a danger which would be absent if the receptacle is kept in a well-lighted shop. On the whole, I consider that the balance of safety is in favor of a light receptacle placed on the ground floor within easy reach of a door, through which it can be removed from the building. It will be seen from what I have said that I regard it of high importance to be able to remove explosive altogether from a building in case of fire, and for this reason I consider it desirable that the chief officer of the Fire Brigade in every town should keep himself informed, not only as to the premises which are registered for explosive, but also as to the position of the receptacle in each case.

Safest Place for Receptacle.

Fire Chief should know Location of Magazines.

Coming now to the causes which lead to the ignition of explosive, I need hardly say that the most frequent cause, and the one against which the most careful precautions must be taken, is the direct application of a spark or flame. The striking of a match in order to examine the contents of the receptacle can only be characterized as an act of reckless folly; but this has been the cause of more than one accident quite recently. A gas flame near the receptacle is not necessarily a source of danger; but if proper care is not taken to keep the receptacle shut and to avoid the spilling of explosive, an ignition may be caused by the care-

Causes of Explosion.

less throwing down of a smouldering match at the time when the gas is being lighted. An ignition from a spark caused by the impact of iron surfaces, or of iron and stone, is of more rare occurrence, but this also must be guarded against. It is advisable to cover the floor immediately round the receptacle with linoleum or other soft material, which will not only facilitate the sweeping up of any spilt explosive, but will also prevent the possible striking of a spark between a nail in the floor and one in the boot of a person approaching the receptacle.

Cover Floor with Linoleum

The spontaneous ignition of an explosive has seldom been the cause of an accident in recent years in this country. It is true that nearly all nitro-compounds, of which smokeless powders are mainly composed, if improperly manufactured, are liable to decomposition, which may lead to spontaneous ignition; but this fact is now so fully recognized by manufacturers that it is rarely that we meet with explosives showing any tendency to such decomposition. Nevertheless, it is not advisable to keep old samples of such explosives, or samples the origin of which is at all doubtful. The tendency to spontaneous ignition is greater in the case of some fireworks containing colored fires, especially when these have been exposed to moisture. At one time there was considerable difficulty on this score, and several fires occurred which were attributable to the spontaneous ignition of colored fireworks. An order was therefore made prohibiting the manufacture of fireworks containing the admixture of chlorate of potash and sulphur, this mixture having been found to be particularly unstable. Since then there has been almost complete immunity from accidents of this description.

Danger from Spontaneous Combustion.

The law of this country prohibits the keeping in one receptacle of explosives which may be dangerous to one another. Thus ammunition which carries its own means of ignition, such as sporting cartridges, is not allowed to be kept with gunpowder; and fireworks, owing to their miscellaneous character, are always to be kept in a receptacle by themselves. There is no danger, however, in keeping any of the varieties of smokeless powders and blasting explosives authorized in this country in the same receptacle, and this is allowed by law.

Different Receptacles for each Explosive.

Some of the worst accidents with explosives which have occurred in towns have originated in the filling of sporting cartridges in gunmakers' shops, but in every case some gross breach of the regulations has led to the disaster. Almost every operation of manufacture carried on with explosives is attended with some degree of danger, and though the operation of filling cartridges is not regarded as one of the most dangerous, it is nevertheless one in which ignitions sometimes occur. Consequently strict precautions should always be taken in the room where the operation is carried out. The most important of these is the limitation in the quantity of explosive present. The law fixes the limit at 5 pounds of gunpowder or smokeless powder. It also requires that no other work shall be carried on at the same time, and that no fire or artificial light of an unsafe kind shall be in the room. In addition to the requirements of the law, it is advisable to limit the number of persons present to two, and also to be careful as to the sweeping up of spilt powder. To facilitate this it is well to have both the filling bench and the floor covered with linoleum.

Size of Package Limited to One Pound.

A further precaution enjoined by law is that no package containing more than one pound of black or smokeless powder may be opened on registered premises. The object of this regulation is to prevent any large amount of powder from being exposed in a shop, and also to minimize the chance of the explosive being spilt. The rule is relaxed as regards the room where cartridges are filled, where, as a matter of convenience, packages containing 5 pounds of powder may be opened.

Laws Controlling the Sale.

In addition to the regulations as to the keeping of explosive, the law of this country restricts the manner of sale; and some of the rules under this heading have a more or less direct bearing on fire prevention. For instance, explosive may not be hawked or sold in a public thoroughfare. Not long ago a rather serious conflagration ensued from a breach of this regulation coupled with criminal recklessness. An enterprising traveler called at a shop with a box of fireworks for sale. In order to show their quality he let one off in the shop. The whole contents of the box became ignited, with the result that the shop was set on fire. Again, explosive may not be sold to children under the age of thirteen, a precaution that needs no comment.

No Sales to Children.

I have dealt only with the keeping of comparatively small quantities of explosives, because where it is desired to keep larger quantities it is necessary to find a place where certain specified distances can be maintained from inhabited houses. Such a place can hardly be described as being in a densely inhabited area, and therefore the consideration of the distances which should be maintained does not lie within the scope of this paper.

Petroleum.

We now come to the consideration of the storage of petroleum, and here we have to deal with a somewhat different class of danger, which must be met by different precautions. From the point of view of fire prevention, I regard petroleum as more dangerous in some respects than explosives. In the first place, it is in more general use and more extensively stored in populous places. If an explosion of gunpowder occurs much local damage may be caused, but usually the whole of the powder will have been consumed, and the resulting fire may not be difficult to deal with. It is otherwise with petroleum. If an explosion of petroleum vapor takes place the damage done may be quite as great as that due to the gunpowder explosion, while the after consequences may be much more serious. The vapor explosion will almost certainly be followed by a fierce conflagration of the petroleum itself, and if any considerable quantity is present the conflagration may be such as to defy the efforts of the most skillful fire brigade. Water is of little use in extinguishing a petroleum fire, as the liquid will float and continue to burn on its surface. Moreover, the burning petroleum will sometimes flow from its original position, spreading the fire as it goes. Cases have occurred where the burning liquid has flowed on to the surface of the water in a harbor and caused serious damage to the shipping. I have no wish to exaggerate the dangers in storing petroleum, but only to indicate the very serious consequences which may ensue from the neglect of ordinary precautions, which, unfortunately, sometimes prevails amongst those who trade in this commodity.

Petroleum More Dangerous than Powder.

Before dealing with these precautions it may be well to say a few words about the properties of petroleum, in order to dispel

Petroleum not an Explosive and not subject to Spontanous Combustion.

certain misconceptions which appear to be rather widely entertained. Strange as it may seem, it is by no means uncommon to meet with well-educated persons who believe that petroleum is in itself an explosive, while others believe it to be capable of spontaneous ignition. These persons generally hold the belief that when the liquid is raised in temperature to a degree known as its " flash point " it explodes, bursts into flame, or else undergoes some marked physical change. These beliefs are, of course, absolutely unfounded.

It would be out of place here to undertake an elaborate discussion of the chemistry of petroleum; suffice it to say that the main constituents are carbon and hydrogen, and that these are bound together in molecular groups according to certain definite chemical laws. These groups contain different numbers of atoms according to the particular variety of petroleum. In general it may be said that the simpler the group and the fewer the number of atoms of which it is composed, the lighter and more volatile will be the petroleum. The simplest groups are gaseous at ordinary temperatures, whilst the most complex are generally solid. Thus what is known as the paraffin series commences with marsh gas, and, passing through the various grades of spirit, illuminating, and lubricating oils, ends in the solid known as paraffin wax. In practice it is seldom that a truly homogeneous variety is met with. All the descriptions of petroleum in commercial use are composed of more than one molecular group. Consequently their degree of volatility is not perfectly definite, and a purely arbitrary test has had to be devised to determine this quality. It is upon the volatility that the danger in the storage and use of petroleum greatly depends.

Vapor Mixed with Air is Explosive.

I have said that the liquid is inexplosive in itself, but the vapor when mixed with air in certain proportions is capable of exploding with great violence when ignited. Fortunately the proportions necessary to form an explosive mixture are very limited. The mixture begins to be inflammable when there is about 1.8 per cent. of vapor. An increase to 2 per cent. renders the mixture explosive, while when the proportion exceeds 4 per cent. the liability to explosion begins to disappear, but the mixture continues to be highly inflammable.

I have said that an arbitrary test has been devised to determine the degree of volatility of any particular variety of petroleum. The test adopted in this country as giving reliable and uniform results, is known as the Abel flash test. This test determines the temperature at which the sample produces a definite amount of vapor under the special conditions of the apparatus. It must not be supposed, however, that below this temperature the oil gives off no vapor at all, or that under other conditions it gives off dangerous amounts of vapor immediately above the temperature of its flash-point.

Flash Test.

The flash test was devised primarily with a view to affording a means of distinguishing between petroleum oil and petroleum spirit (gasolene) for legislative purposes; or in other words in order to be able to draw a line between the varities of petroleum which are in common use for illuminating purposes, and those which are so volatile as to require special restrictions in storage. For reasons which it is not necessary to enter into, the line has been drawn in this country at a flash point of 73 degrees Fahr. by the Abel test. Oil above this flash point is not subject to any legislative restriction, while petroleum spirit which is below may not be kept, except in very small quantities, without a license. An exception has recently been made in the case of spirit kept for use in motor cars, for the keeping of which general regulations have been made.

Petroleum should be kept in Metal Vessels.

Petroleum should be kept in metal vessels wherever possible. I regard this as imperative in the case of spirit, having recently had experience of the danger of leakage of vapor through wooden barrels. Such barrels are still strongly advocated by some persons, both for the conveyance and storage of petroleum, but in the case of spirit I find their arguments entirely unconvincing. One of the principal virtues of a wooden barrel when used for an aqueous liquid is that the liquid swells the wood, and by increasing the pressure between the staves diminishes the chance of leakage. This quality is entirely lost with petroleum, which, though it permeates the wood, has no

effect in swelling the staves. Consequently to keep the petroleum from all leaking out, it is necessary to coat the interiorof the barrel with glue. When this coating is fresh, the barrel may be fairly free from leakage; but when owing to dry weather the staves have shrunk, or when the barrel has been knocked about, the glue coating becomes defective, and more or less leakage inevitably occurs.

Metal vessels are invariably employed for the petroleum spirit used in motor cars. This is partly due to the fact that the above-mentioned regulations require that this spirit should only be kept in such vessels of a capacity not exceeding two gallons, and partly to the refusal of the railway companies to carry it otherwise than in metal vessels. The licenses of most local authorities contain a similar provision. It is possible that at some future date the use of wooden barrels for petroleum spirit may be prohibited altogether.

Should be Stored Outside Building, never Under Stairway.

As to the place where the petroleum should be stored, it is very desirable that this should be outside the fire-risk of a dwelling-house, that is to say, in some building wholly detached or separated by a fire-proof wall. Probably the safest method is in an underground tank separated from all buildings. Where, however, it is necessary to store petroleum inside a shop or dwelling-house, the best position is a well-ventilated cellar, from which the oil may be drawn by means of a pump in the case of retail dealers. The worst place of all is under the main staircase.

The metal tank in which the oil is stored should be hermetically closed, with the exception of an air hole, which should be covered with very fine copper wire gauze. In the case of fire the oil in such a tank may all burn away without seriously adding to the conflagration, or may even escape ignition altogether. Of course, water must not be played into the tank, as this would have the effect of floating out the petroleum. In every place where petroleum is stored, there should be a supply of sand and a shovel. This is useful, not only for absorbing any spilt petroleum, but also for extinguishing fire in its initial stage.

The quantity of oil which may be kept in any place is unlimited, but in the case of spirit (gasoline) it is governed by the conditions of the license, and varies according to circumstances. Users of motor cars are allowed to keep 60 gallons, which must be contained in 2-gallon metal vessels.

60 Gallons of Gasoline is Limit of Stock for Automobile Owners.

The most important precaution is the exclusion of naked lights from the neighborhood of the petroleum. If only oil is present, it is sufficient to guard against a light being taken into the immediate vicinity of the vessel in which the petroleum is kept, but in the case of spirit, an ignition may take place at some distance from the actual vessel if there has been any leakage, as the vapor is heavier than air and has a tendency to flow or drift with light currents of air to a considerable distance before it is so far diluted as to become uninflammable. For this reason a naked light should not be taken into any store or room where spirit is kept or used, and care should be taken that there is no fire or light in the vicinity of such store or room. In general, the store should only be entered during daylight, but if it is necessary to enter at night a safety lamp such as is used in coal mines should be employed. Some persons think that a lantern is sufficient protection to a light, but this is not the case unless every communication between the flame and the outside air is closed by very fine metal gauze as in the safety lamp.

Very Important to Avoid Naked Lights.

An electric spark is quite as dangerous in producing vapor ignition as an open flame. Several fires have been caused by the ignition of petroleum vapor by means of the tiny spark given off by a textile fabric which has become electrified. If electric light is installed in any building in which petroleum spirit is stored or used, this should only be done under the advice of an expert thoroughly acquainted with the special risks to be guarded against. Time will not permit of my doing more than touching on the general principle which should underlie such installation. The lamps themselves should be enclosed in strong glass outer globes fitted on with an airtight joint. The wires should be well insulated and should preferably be contained in metal pipes connected to earth. All switches and fuses should be outside the building beyond the

Danger from Electric Spark.

reach of vapor unless they are of such special construction or are so enclosed in metal cases that the vapor cannot possibly reach the interior. In general no current-bearing part, that is, no metal part in connection with the source of supply, should be exposed.

Danger from Empty Barrels.

As in the case of explosives, no highly inflammable material should be kept near the petroleum. In this connection it may be well to mention the danger which may arise from empty petroleum barrels. It is commonly supposed that the fire risk is at an end as soon as the barrel is empty, and such barrels are deposited anywhere regardless of possible ignition. The wood being saturated with petroleum these barrels are often highly inflammable, and when they have contained spirit are generally full of vapor. Several accidents have occurred through mischievous boys putting lighted matches to the bungholes of empty spirit barrels.

Explosion from Gasoline in Sewer.

A necessary precaution is to guard against petroleum, especially spirit, finding access to the sewers. Not long ago I was called upon to investigate a curious explosion, fortunately not followed by a fire, which occurred in a dwelling-house in the North. The cause was traced to the washing out of partially emptied spirit-cans into the sewers at a distance of about 200 yards further up the street. The vapor from the sewer had found its way into the house through defective drains. Special care should be taken where any large quantity of petroleum is kept, that there shall be no outflow of the liquid in case of fire. Where the tank is not underground, it should be surrounded by a trench or dwarf wall, or should be placed over a cavity capable of containing the whole of the liquid should the tank be damaged by fire.

Carbide of Calcium.

We now come to the consideration of the precautions to be taken with a chemical product, the importance of which is growing very rapidly, namely, carbide of calcium. This material is manufactured in the electric furnace by the action of coke or other form of carbon on lime at a very high tempera-

ture. Its principle use is in the production of acetylene, which is a gas having a very high illuminating power. Owing to the very simple method by which this gas is produced, and to the great brilliance and whiteness of the light which it gives, it is specially adapted to certain kinds of illumination. The demand for carbide is therefore already considerable, and as the popularity of the light increases, the storage of this chemical will become more and more important. In this country the material has been subjected to restriction by bringing it within the scope of the Petroleum Acts, so that it is made illegal to store quantities greater than 5 lb. without a licence.

Carbide of calcium is of itself absolutely inexplosive and uninflammable, and its sole danger lies in the readiness with which it gives off a highly inflammable gas from the mere contact of water or moist air. As long as the carbide is stored in hermetically closed vessels therefore, it is quite harmless. Even if these vessels are exposed to fire in a burning building, no dangr arises provided that the water is not played on the contents.

Acetylene, like all the other inflammable gases, tends to form an explosive mixture with air, but it differs from other gases in the very wide range of proportions in which it is capable of forming such a mixture. Thus, when the proportion of acetylene in the air reaches three per cent., the mixture commences to be explosive, and continues to be so under certain conditions until the proportion is over 80 per cent. The maximum explosive force is reached when the proportion of gas to air is half and half. The reason for this wide range is to be found in the fact that the gas possesses explosive properties in itself without any admixture of air. When raised to a pressure of two atmospheres or even less, acetylene alone will explode with very great violence on the application of a flame or spark. For this reason the compression of this gas is not allowed in this country except under very special conditions.

Store in Metal.

From what I have said of the properties of carbide of calcium, it would appear that only one precaution is necessary for its safe keeping, namely, that it should be contained in a hermetically sealed metal vessel. This is indeed the principal pre-

caution necessary, but inasmuch as it is difficult to ensure that vessels shall be at all times absolutely impervious to moisture, and as these vessels have generally to be opened at times for the removal of their contents, it is desirable also to add certain other precautions. The vessels in which the carbide is contained should be kept in some dry, well-ventilated place and should be protected from the weather. No large amount of the material should be stored in any shop or dwelling-house, or in any highly inflammable building; and when a fire does break out in or near a carbide store, no attempt should be made to extinguish it with water if there is any likelihood of the carbide being wetted.

Avoid Water in Case of Fire.

Excepting in the case of storage inside houses or shops, the quantity to be allowed in any one place is of little importance, because when more than a very limited quantity is kept, the danger is measured more by the amount of water which can find access to the material than by the amount of carbide present. In order to generate the full amount of gas from any quantity of carbide, it is necessary to add at least an equal weight of water. The precaution in regard to naked lights, which is all-important in the case of stores for petroleum spirit, is not so necessary in places where carbide is kept, because if the precautions which I have just mentioned are observed there will not be much chance of the formation of gas, and what little is formed will be readily carried away in a well-ventilated building. Unlike petroleum vapor, acetylene is of approximately the same specific gravity as air, and mixes easily with the atmosphere. A naked light should not, however, be taken near one of the carbide vessels when it is opened, as gas is sure to have accumulated inside, and it is wise to exclude them from the building altogether. In the case of the building in which an acetylene generator is installed, the precaution as to naked lights should certainly be observed, and on no account should the generator be examined with a lamp capable of igniting a gaseous atmosphere. Several serious accidents have occurred from the neglect of this very obvious precaution. In places where acetylene is used, more danger may arise in connection with the generation of the gas than in the storage of the car-

Avoid Naked Lights about Storage Vessel.

bide. It would be beyond the scope of this paper to deal with the conditions of safety in the design and construction of acetylene generators, and I will therefore refer those interested in this matter to the report on the subject by a committee of eminent experts, which was published as an official document last year. One precaution in connection with the generation of acetylene I may mention, and that is to avoid discharging the sludge or spent carbide from the generator direct into a sewer. Unless this sludge has been immersed for some time in a large volume of water it may continue to give off gas in sufficient quantity to give rise to danger in a sewer or other confined space.

Report of Experts on Acetylene Generators.

Other Chemicals.

It would be impossible within the limits of this paper to deal with all the numerous chemicals which under certain conditions are capable, directly or indirectly, of causing fire or explosion. Strong acids when they come in contact with certain other substances may develop sufficient heat to cause a fire, and it is conceivable that caustic alkalis may do the same. Quicklime, owing to the heat evolved in combining with moisture, has, I believe, often been the cause of fires, and the metals sodium and potassium give rise to still greater danger on the same account. It is well known that these metals burst into flame and even cause explosion on coming in contact with water or any substance containing moisture; but it was at one time doubtful whether exposure to moist air was sufficient to cause ignition. This doubt was set at rest by Dr. Dupre, Chemical Adviser to the Home Office, who carried out experiments at my instigation. He found that although the rate of oxidization of sodium in moist air was too slow to raise the metal to the temperature of ignition, yet the soda formed is so hygroscopic that drops of moisture accumulate on the surface; and if one of these drops runs down on to a portion of the metal less oxidized, an ignition takes place. I believe this to have been the cause of a serious explosion which occurred in a small building in the exhibition grounds at Earl's Court a few years ago, where both sodium and gunpowder were stored.

Explosion Due to Sodium.

Danger from Sodium Peroxide.

Another substance which gives rise to considerable fire risk on account of its affinity for water, is sodium peroxide. This chemical is used as a producer of oxygen, which it readily gives off when acted upon by water. When pure its behavior is somewhat remarkable. Dr. Dupre has shown that a piece of sodium peroxide if rubbed against the surface of a piece of wood will set it on fire, and if the peroxide in a powdered condition is sprinkled on wood shavings, a drop or two of water is sufficient to make the whole burst into flames.

The dangers with those chemicals which I have described suggest their own remedies. Strong acids and alkalis should be kept out of reach of other chemicals, and care must be taken to confine them in their own containing vessels. Chemicals having a strong affinity for water should be stored in hermetically sealed receptacles, preferably of metal. Sodium peroxide must be kept away from wood or other carbonaceous material. The metals, sodium and potassium, if required for immediate use, may be kept in heavy mineral oil, but care should be taken that they are entirely covered by the liquid.

Bisulphide of Carbon.

We now come to the class of chemicals, which, like petroleum, give off inflammable vapor. Foremost among these is bisulphide of carbon, which is used to some extent in the arts as a solvent. Not only is this extremely volatile, but it presents the additional danger that its vapor ignites at a comparatively low temperature. According to one authority, the igniting point of carbon bisulphide vapor is as low as 149° C., so that it might be ignited by a high-pressure steampipe. This liquid has a high specific gravity, which enables it to be kept under water, in which it is insoluble. Several other liquids used as solvents give off inflammable vapor freely, as for instance, ethers, alcohols, acetone, amyl acetate, turpentine, etc. For all these the precautions in storage should be much the same as for petroleum spirit.

Phosphorus.

The fire risk of phosphorus in the crystalline form is well known. This substance should invariably be kept under water. Phosphide of calcium, on coming in contact with water, gives off a gas—phosphoretted hydrogen—which ignites spontaneously in air. This property is taken advantage of in certain

marine lights, which are arranged to take fire by the mere act of throwing them into the water. This chemical must, of course, be stored in hermetically sealed vessels, but, owing to its very dangerous nature, it should not be kept at all in any shop or dwelling-house.

Some of the coal-tar products used in the dyeing trade possess explosive properties, but these are mostly of a feeble order, and the materials themselves are not, as a rule, highly inflammable. Picric acid, however, is capable, under certain conditions, of exploding with great violence, and is now practically treated as an explosive in this country, where it is subjected to many of the restrictions which apply to other explosives. This acid is now little used as a dye, but there has been a considerable demand for it as a military explosive. It was long doubted whether picric acid alone was capable of explosion, in the absence of a detonator or of some metallic picrate. Experience has, however, convinced me that when any considerable quantity is involved in fire, a violent explosion may result, even when no metallic substance capable of forming a picrate is present. Some of the metallic picrates are violently explosive, especially picrate of lead. In contact with iron, picric acid forms a picrate which is very sensitive to friction, and has been the cause of more than one ignition of picric acid in manufacture.

Picric Acid.

The next chemical to be considered is chlorate of potash, which owes its uses to the fact that it is an efficient oxygen producer. It does not give up its oxygen except under the influence of heat or chemical reaction, and is therefore stable at normal temperature, and free from liability to spontaneous ignition. Its danger lies in the readiness with which it forms explosive mixtures with carbonaceous material, especially under the action of fire. Thus if, during a conflagration, melted chlorate became mixed with some powdered or melted organic matter, a serious explosion might ensue. In very large quantities it is capable of exploding by itself in the course of a conflagration, as was shown by a serious explosion at St. Helen's a few years ago. It also has the property of rendering any woodwork or fabric with which it has come in contact very highly

Chlorate of Potash.

inflammable, and where it is involved in a fire it will intensify the conflagration by supplying oxygen to the flames. Chlorate of potash and other chlorates should, therefore, be kept away from strong acids, and from any carbonaceous material with which it could possibly mix, and should not be stored in inflammable buildings. Saltpetre and other nitrates are also oxygen bearers, but are not possessed of explosive properties, nor do they readily form explosive mixtures. They are, however, capable of intensifying a conflagration, and of rendering woodwork more inflammable from a spark, though in a less degree than chlorate of potash. It is better, therefore, that nitrates should be stored in an uninflammable building.

I have dealt with the above chemicals somewhat briefly, partly in order to keep this paper within reasonable limits, and partly because few of them are likely to be extensively stored in densely inhabited areas. It must be remembered, however, that in the case of those which are liable to cause ignition, a disastrous fire might be initiated by even a very small quantity of the chemical.

DISCUSSION.

Chief Officer GIERSBERG—In Germany the tradespeople are against the regulations which the local government wish to enforce, namely, the ventilation of the small stores of benzine and petrol. They maintain, first of all, that the petrol vapors are very heavy and therefore they are lying at the bottom, and with ventilation they could not be removed; secondly, they say if there is natural or artificial ventilation in a cellar, or some convenience of that kind, the draught may cause an explosive mixture which would be rather a source of danger than a protection. I would therefore ask whether such ventilation should be introduced, and, if so, in what way?

Dr. PAUL DVORKOVITZ—I wish to make some remarks, especially on petroleum. I do not agree with the lecturer where he regards petroleum as more dangerous in some respects than explosives, from the point of view of fire protection. If the lecturer would confine his remarks with regard to light vapors to benzine I may agree with him, but to put petroleum under the same description as an explosive, I think, is very harsh on

the industry which I represent. After all, the flash point which is introduced here has given quite sufficient protection with regard to the formation of explosive vapors. I quite agree with what the lecturer says with regard to storing barrels of petroleum under the staircase, but in other respects petroleum in itself, in my opinion, is not in any way dangerous. It is highly necessary you should convey to the people that petroleum and petroleum spirit are not the same. They say we have handled petroleum for 20 or 25 years, and there is no danger whatever, and they will argue that petroleum spirit is just the same. In my opinion the precautions which the lecturer commends with regard to the keeping of petroleum spirit are very practical, and would not in any way be harsh on the trade. There is one other question about keeping petroleum spirit in wooden barrels. I have had a great many disputes and discussions about this, and, as far as I can judge, the trade itself thinks that, especially in the summer time, it is much more preferable to keep petroleum spirit in wooden barrels than in iron drums. In excessive heat the iron drums are more largely heated than wooden barrels, and they think that evaporation will be very great indeed. As to the question of accidents, and so on, after all, petroleum spirit evaporates very quickly and mixes with the air. What you want with petroleum barrels is always to have proper ventilation, and this is where the question of Chief Officer Giersberg comes in about ventilation, as to what you call proper ventilation; and if the objection which has been mentioned by the trade in Germany is not well founded, that by introducing artificial ventilation you create another source of danger—namely, forming explosive elements.

Captain THOMSON—With regard to the question of ventilation, I think I can answer both gentlemen at the same time, because it, to a large extent, hangs on the use of wooden barrels. If petroleum spirit is kept in wooden barrels, it is not well to ventilate the store too thoroughly, because, for the reason which I gave in the paper, the staves of the barrel are liable to be shrunk and the leakage to be increased; but I do not agree that owing to the rapidity with which the petroleum spirit volatilizes there is no danger from a leakage. If you

have a leakage going on there will be fresh spirit to replace what has been volatilized, and you will have a large evolution of vapor. Really in a store in which wooden barrels are used it is no good to ventilate; because the more you ventilate, especially in dry weather, the more vapor will be evolved, and that is one of my strongest reasons against wooden barrels. As regards a store in which petroleum is kept in tanks, I certainly think there should be ventilation, and in that case it is always well to arrange two openings, or more than two openings, one low down and one high up; then, of course, you get a circulation of air, and the vapor will be carried away. If you merely have an opening in the roof you will not carry away the vapor, because, as has been said, it is heavy and will tend to lie at the bottom of the building. As regards the question of danger, I think perhaps I did not make myself quite clear, although by mentioning the fact that petroleum vapor may cause as bad an explosion as gunpowder I implied that I was speaking only of the spirit. In the case of petroleum oil, where no vapor is developed, the danger is certainly not as great as gunpowder, but there is this to be said, and I would impress it on all persons who have to deal with petroleum, if ignition once takes place it does not make much difference whether it is petroleum spirit or petroleum oil which is involved, both liquids will burn fiercely; both liquids will tend to flow burning, if such outflow is not prevented; and both liquids are very difficult to extinguish by ordinary methods. I do not wish to discourage any one from using petroleum oil by saying it is dangerous; what I wish to encourage is the taking of all reasonable precautions, whether they are enjoined by law or not. I have seen in this country the most reckless folly in connection with the storage of petroleum oil; I have seen large tanks of oil with taps dripping on to the floor and two or three lamps just by, and a man smoking, and so on. It is really marvelous that there are not more serious oil conflagrations in this country.

SECTION III.

FIREPROOFED WOOD AS A BUILDING MATERIAL.

By Professor Ira H. Woolson, *Columbia University, New York.*

In the construction of large buildings, the question of fireproofness has at last assumed its proper position at the head of all other questions concerning the manner of construction.

As representatives of this twentieth century, we congratulate ourselves upon our advanced civilization, and our industrial and scientific development, but it is a lamentable fact that numerous problems of vital importance to the life and happiness of our race are still unsolved through stupid neglect.

Two of these problems are fireproof construction and sanitary regulation of disease. There is little cause for complaisancy over these subjects when contrasting the world's condition to-day with that of two or three centuries ago.

Fortunately we are at last awakening to the gravity of the situation, and material advancement has been made in the past decade. It has taken us 2,000 years to learn that great conflagrations are the result of human neglect and ignorance, rather than visitations of Divine wrath. The same is true of widespread plagues and distributed malignant diseases.

We have made marvelous progress during the past few hundred years in the method and magnitude of our building operations. The introduction of iron and steel into this class of construction marked an era in architectural history. With their advent came the use of the term " fireproof construction." It was fancied that steel beams, iron columns and tile or concrete floors would make a building indestructible. Alas! we know to our sorrow that the term " fireproof " is often a delusion. Buildings, as generally constructed during the past twenty-five years, were no barrier to fires, and, as matter of

fact, not so safe as if built of solid wooden beams. These would at least be slow-burning, and not wreck the whole building by the buckling of columns and beams as soon as heated.

Our cities are filled with magnificent structures, marvelously constructed, but a very small percentage of them are at all fireproof. It is absolutely true that our great cities to-day are but little less inflammable than they were in 1666, when this city was swept by fire from Tower to the Temple, with results sufficiently awful to make a period in history. Similar conflagrations have occurred with painful frequency all over the world since that time, and now, after a lapse of 250 years, are still of yearly occurrence. Were it not for the high efficiency attained by the noble body of men, the firemen, in all our cities, consequences of fire would be far more appalling than they are. This is particularly true in America, where the craze for high buildings has made the fireman's work doubly hazardous.

The time has come when all permanent construction should be strictly incombustible. That the public has awakened to this fact is evidenced by this gathering of representative men from all parts of the world to discuss the various methods of solving the problem.

The necessity of *fire prevention* is beginning to be appreciated. Energy and money are freely spent in exploiting all kinds of fireproof construction. Fortunately the public has lost its credulity, and no longer accepts the statement that a system of construction is fireproof unless it is *proven* to be such by practical test. Your chairman, Mr. Sachs, is one of the pioneers in this class of experimental testing. His splendid work during the past few years by sifting the meritorious processes from numerous trashy ones, has aided greatly in classifying the many proposed methods of fire protection.

In the United States during the past few years much investigation of this character has been done by the New York City authorities, also by the National Board of Underwriters at their testing laboratory in Chicago, and by the Insurance Engineering Experiment Station in Boston. All are doing excellent work. I am informed that much similar work is

being accomplished by experts in various continental cities. I regret that I have been unable to secure records of their work.

If this class of investigation receives the support it deserves, the results will be invaluable, and reduce to a minimum the fire hazard of large buildings. Among the various materials for reducing fire risk is the so-called "fireproof wood." It is upon this subject your executive has kindly requested me to address you to-day.

Mistake to Use the Term "Fireproof."

First of all, let us have a clear understanding of what is meant by the term "fireproof wood." For the information of those unfamiliar with the subject, it should be stated that the term "fireproof wood" is a misnomer; for all such woods will burn if exposed for a sufficient time to a high degree of heat. Strictly speaking, the processes of treatment do not make the woods *fireproof,* but simply render them fire retardants. Fire resistant wood is a much more logical term. The public has been somewhat deceived by the representatives of certain processes who make the silly claim that wood treated by their methods are rendered absolutely incombustible. Such statements are foolish, for they lead to expectations of resistance which cannot be achieved. When the deception is discovered it causes unjust criticism and mistrust of the whole product.

The term "fireproof wood" is a trade name, and should not be taken in a strictly technical sense.

Use of this Wood in New York City.

New York City is probably now using more fire resisting wood than any city in the world. This results from two causes; first, the Building Law, which requires that such treated wood shall be used throughout all buildings over 12 stories (or 150 feet in height); and secondly, to the fact that the city proper is too limited in area to spread, and enormously high buildings have become necessary. Scores of buildings erected during the past two or three years are over 15 stories high, and many of them 25 and 30.

It has been my privelege, under the direction of the Bureau of Buildings, to test most of the wood which has been used in these buildings. For the year ending the first of this month, I have tested and reported upon upwards of 3,500,000 feet. The greatest part of this material was for floors, which were

laid on the top of strictly fireproof floor construction of the concrete or hollow tile. The balance of the material was used for trim. An evidence of the magnitude of building construction now going on in that city, is the recent filing of plans with the Bureau of Buildings for one structure in which 2,000,000 feet of fireproof wood will be required.

Companies Manufacturing.

I would here add that there are at present three companies, viz., the Fireproofine Manufacturing Company, American Wood Fireproofing Company and the Electric Wood Freproofing Company, supplying this treated wood to the City of New York. There are other companies established for the same purpose in Philadelphia and Montreal.

The impregnation of wood with chemicals to render it fire-resistant is by no means a new idea. Numerous experiments with various chemicals were made as early as 1825 by Fuchs, Gay-Lussac, Boucherie, and later by Lochtin and other continental chemists. However, it is within the last few years only that the business has been put upon a practical commercial basis.

It is conceded by most experts who have carefully studied the subject, that the fireproofing of wood is a safeguard, and under ordinary conditions, will greatly reduce the fire risk. It will, however, be consumed by continued application of flame, and under certain conditions especially favorable to fire, may support a slow combustion by itself, but the same conditions of heat would also ruin many other accepted fireproof materials. To my mind, the non-inflammable nature of the material is its greatest value.

Action of Wood in a Fire.

When a fire occurs in a room trimmed with ordinary wood, its inflammability makes it immediately dangerous. The flames leap from one point to another, dashing through windows and transoms, thus spreading the fire to adjoining rooms. If the wood is finished with oil or varnish, the flames will run along it with marvellous speed. If finished with well-treated wood this tendency of spreading the flames is reduced to a minimum, even if the burning material in the room is sufficient to ignite the treated wood, it burns so slowly that life and property are much less menaced. It would at the worst be a dis-

tinctly slow-burning conflagration. That in itself is a great safeguard, because it allows time for the arrival of the firemen.

Numerous inorganic materials are being exploited to replace wood entirely in fireproof construction. If it were possible to find a substitute for wood, which possessed its merits and none of its failings, it would be most desirable. So far, I have never seen anything which had the lightness, strength, durability, cheapness, ease of working, and last but not least, the elements of beauty for decorative purposes which wood possesses. For these reasons it will surely long remain a favorite with architects.

Granting the value of fire-resistant wood as a structural material, the next problem is to determine what degree of fireproofness should be exacted, and how the standard of quality can be maintained.

Not being acquainted with the methods employed on this side to accomplish these objects, I will confine my remarks to our practice in New York.

In the early stages of experimentation it was customary to build a small house of the wood to be tested, usually duplicated by a house of untreated wood; then applying a vigorous fire both inside and out, and noting the results. This method possesses spectacular elements which are very convincing, and while it may be useful as a general test to demonstrate the degree of immunity from fire that a wooden building may be made to possess, the heavy expenditure of time and money required for such a test precludes the possibility of employing it for regular series work. This is the only value such a demonstration possesses, for the results of fire tests made upon wood treated a year or so ago, may bear no relation to the product of the same company to-day. It is essential for public safety that regular serial tests should be made upon all material delivered for use, as is the custom in the manufacture of steel, cement and other structural materials.

Methods of Test.

Unfortunately there is no recognized standard test for fire-resisting wood. In America a variety of tests have been proposed by different investigators, most of them being the direct application of heat or flame to small test specimens, and noting the duration of flame and glow produced, as well as the amount

of wood consumed. One method recently proposed makes the amount and character of gas given off from dry distillation of small fragments of wood a basis of classification, but no uniform method has yet been adopted.

An effort was made a year ago by the Building Bureau of New York City, in conjunction with the various fireproof wood manufacturing companies, to decide upon some standard method of test. But the project was abandoned. The present method of testing is as follows:

When a shipment of lumber is prepared, an inspector proceeds to the works and selects at random one sample from every 2,000 ft. of material. This is sent to the laboratory and tested; reports being sent to the Building Bureau and the manufacturer. Two tests are applied to each sample. One a "shavings test," which is a test used by the U. S. Navy, and the other a test devised by the writer, which for want of a better name is called a "timber test."

Shavings Test.

The shavings test, while useful in a general way to determine the flaming properties of treated wood, is, nevertheless, unsatisfactory. We are now making series of different tests in an endeavor to supplant it with something more reliable. The test is conducted as follows: A pan 1 foot in diameter and 6 inches deep is mounted on legs. The bottom is formed by a heavy wire screen of $\frac{1}{2}$-inch mesh. This wire bottom is covered with a layer of shavings 2 inches deep, and a Bunsen burner is applied underneath for twenty-five seconds; then the burner is removed, and the lengths of time during which the shavings support (1) flame and (2) glow are recorded, and also the area of shavings burned.

The idea of this test is that shavings from properly treated wood will not support flame any considerable time, and that the flame will gradually die out without material enlargement of the burned area. After test, the remaining shavings are thrown away. There are no means for making a permanent exhibit of the results, except by photographs, which would be difficult to take and quite unsatisfactory. The wood must be accepted or rejected on the judgment of the operator, based upon notes taken while observing the test.

Besides these obvious disadvantages, there are two other strong objections to the shavings test; first, the extreme difficulty of always maintaining the same conditions of flame and heat under the shavings; and, second, the impossibility of securing a uniform quality of shavings for tests. The Navy specifications call for the use of the Bunsen burner with a flame giving about 500 degrees Centigrade, equal to 932 degrees Fahrenheit. Now, Bunsen burners vary considerably in the size of flame they produce, so, although every precaution was taken and the same standard temperatures were determined in each of two flames at some definite point, the results of tests upon the same kind of shavings might show widely different figures, because of the general variation in the character of the flames. Much depends also upon how and where the tests are conducted; whether under a smoke hood with a strong draught, or in an open room where air currents could strike the flame and cause it to sway. The most serious objection, however, to the shavings test, and the one which, in the writer's opinion, is fatal to its use as a standard method of comparison, is the impossibility of making the shavings of uniform size and quality. The samples here exhibited demonstrate the objection made.

These shavings were all made by the same carpenter and were as nearly alike as possible for him to make them. You will note that some are fine like sawdust, while others are very coarse, with all graduations of size between. Another objection is that in coarse grained wood like oak, the plane, in making the shaving, splits many of the large pores and allows the crystallized chemical to fall out, thus removing a part of the fire-resisting agent. Lastly, no wood in the form of shavings would be exposed to fire in a building. It would seem that further evidence is unnecessary to demonstrate the inappropriateness of this test alone as a standard of comparison.

Timber Test.

To avoid the difficulties of this and similar tests, the previously mentioned "timber test" was designed. Though not entirely satisfactory, the results, as a whole, have been gratifying. During the past two years, the writer has conducted over 4,000 tests upon fireproofed wood, the majority

being " timber tests." Scarcely any criticism of the *method of test* has been offered by clients, though the results were often not gratifying.

Heat Applied.

The specimens for this test are accurately cut to a size 1½ inch by ¾ inch by 12 inches. These " timbers " are tested in pairs by being laid across the top of a 6-inch gas crucible furnace, in which a constant temperature of 926 degrees C., equal to 1,700 degrees F., is maintained. This particular temperature was chosen because it is given by the New York Building Code as approximately the heat of a burning building. At the end of two minutes the specimens are removed, and duration (1) flame and (2) glow noted for each.

The temperature is under constant control by means of a Le Chatelier pyrometer, the " couple " being placed between the two specimens, thus recording the heat exactly at the point of application. The proportions of gas and air are regulated to furnish a vigorous flame 8 to 10 inches above the furnace, so imitating an ordinary fire.

After test, the specimens are sawed in two at the middle and tracings made of the unburned wood. These tracings are then carefully measured by planimeter and the percentage ratios to the original cross-section calculated. The percentage of unburned wood is printed upon the tracing of each specimen, and then blueprints are made which become a part of the permanent record.

The accompanying exhibit contains samples of these blue prints, also a number of tested specimens of different varieties of wood, both treated and untreated, showing the comparative results in each instance. It will be noted that the tested specimens show a straight line in the cross-section on the side not exposed to the fire, whereas the untreated specimens are burned on all sides. This is good evidence of the fire-resisting properties of the wood. In general, the untreated woods show a cross-section area approximately 10 to 25 per cent. less than the treated samples. However, the value of the " fireproofed " wood cannot be rated by this feature alone. Account must be taken of the tendency to ignite and support combustion. This is indicated by duration of flame and glow,

after the specimen is removed from the fire. In every instance the contrast in time of flame and time of glow, between the treated and the untreated wood, is very marked. The average duration of each taken from 688 tests on four varieties of treated soft woods was 7 and 12 seconds. The same data taken from 846 tests on four varieties of treated hard woods was 10 and 14 seconds.

Similar calculations based upon tests of untreated wood, though not averaged from nearly so many tests, gave for soft woods, flame, 1 min. 19 sec.; glow, 1 min. 53 sec.; and for hard woods, flame, 2 min. 31 sec.; glow, 6 min. 29 sec.

Those figures give a ratio of 1 to 11 and 1 to·9 for flame and glow between treated and untreated soft woods, also 1 to 14 and 1 to 27 for hard woods. That is, the tendency of untreated woods to burn is 10 to 20 times that of treated woods. This measure of the property of retarded combustion is as important as the determination of the percentage of unburned areas, for in the first stages of a fire, minutes are valuable. Experience has shown that a variation of 5 per cent. should be allowed in cross-section area, because of structural differences in the wood, fluctuation in temperature, and personal error in measuring. In fact, like all investigative work, it is never safe to estimate average values from the results of a few tests.

The advantages of this method of test are: (1) a test piece of uniform size, large enough for practical comparisons, and small enough for numerous tests to be made with slight waste of material, thus insuring a fair average report; (2) a constant temperature and uniform time of application of heat; (3) an estimate of the tendency to support combustion as indicated by the times of flame and glow; (4) the ability to accurately measure the amount of burn, and make a drawing of same for permanent record—the specimen itself can also be easily preserved for future reference if desired. In brief, every element of the test is practically constant, except the character of the wood and the treatment it has received. Necessarily these must always remain variable.

The lumber is thoroughly dried before testing, and care exercised to keep everything uniform.

The specimens are placed so the side which was originally the outside surface of the board faces the fire. This is necessary because the Building Bureau permits one inch outside treatment on floor sleepers and other large materials, which is encased in concrete or a coating of other fireproofed wood.

It will be noted that hard woods, like long leaf yellow pine, oak and maple, when treated, differ only slightly in unburned area from untreated lumber.

They are naturally " slow-burning " material. It would scarcely be necessary to fireproof hard wood if the preservation of structural strength were the only consideration. But the danger from inflammability should make a surface treatment imperative. Soft woods which waste rapidly under flame should be treated throughout.

Defects.

Although treated wood has many advantages as a fire retardant, it also has its failings, the worst being its tendency to become hydroscopic. There are processes which claim avoidance of this tendency to gather moisture when exposed to dampness, but I have had no opportunity to prove their merits. Because of this difficulty, the Navy has discontinued the use of fireproofed wood, except for interior trim, furniture, etc.

When in this damp condition a new difficulty arises, because the chemicals employed produce a corrosion on metals. Neither of these difficulties appear harmful where the wood is ordinarily dry and protected by paint, varnish or oils.

A strong point in favor of the treatment is, that the wood does not seem to become perceptibly more combustible by the application of oils and varnish. Among the experiments I will make at the conclusion of this paper is one designed to demonstrate this feature.

A further defect of treatment is to weaken the wood and make it brittle. Although this does not always result, it is a recognized possibility, and the Navy specifications reject

material which has lost over 30 per cent. of its original strength.

In New York City no attention is paid to the question of strength, for the method of steel construction does not require the wood to support loads.

Whether the treatments are permanent, I am not prepared to state. Our experience with them is too short to predicate a positive opinion. Samples kept in my laboratory two years show no signs of deterioration, and we have here some samples treated in 1895 which we will test to show they still retain their fire-resisting qualities.

Some processes, however, do employ volatile chemicals, as is evidenced by a bloom which appears on the wood after standing for some time; it is also shown upon the sides of these jars of shavings, which are about two years old. So far as my experience goes with lumber treated for New York City, there is very little tendency for this sort of deterioration. Neither has there been any evidence of decay. When used under ordinary conditions of dryness, and protected as it usually is, I see no reason why well treated wood should not remain sound and effective indefinitely. However, I believe the question is one to be systematically investigated.

There are two other well-known defects, namely, discoloration and difficulty in working due to hardness. Both of these are increased by excessive treatment, hence the manufacturer is always tempted to lessen the treatment. This fact is the only argument necessary for regularly testing the material as delivered for use.

Last, but not least, from a builder's point of view, the wood is costly. But considering the awful destruction of life and property which fire constantly causes, the saving of expense should not be allowed as an excuse for the use of inflammable materials which invite public calamity.

After some discussion and questions, the Chairman proposed a vote of thanks to Professor Woolson for the very interesting paper he read, which was carried with applause.

SECTION IV.

FIRE PATROL SERVICE FOR DOCK PROPERTY.

(FIRE PREVENTIVE METHODS AT THE DOCKS OF THE MANCHESTER SHIP CANAL.)

BY W. H. HUNTER, M.Inst.C.E., *Chief Engineer, Manchester Ship Canal.*

The asphorism that " in a theatre the only effective method of fire prevention is the application of the carpenter's cap," which of course means that fire prevention, as distinguished from fire extinction, can only be undertaken successfully (1) at the point of origin of the outbreak, and (2) at or near the time at which the outbreak occurs; applies with equal, if indeed with not greater force, to large modern dock systems with their vast and ever-increasing equipment for the loading and discharge of cargoes, as well as their huge but essential accommodation for the handling and housing of the goods; whether temporarily in transit sheds, or for more lengthened periods in warehouses or stores.

The bulk of the cargoes has grown so great, their intrinsic value so enormous, the speed at which it is required that they should be distributed so excessive, that a complete revolution in the methods of dealing with materials when their conveying steamers are safely berthed in a dock, has taken place within a comparatively limited period. The " old order " has changed and has given " place to new " in all ports and harbors which are abreast of the times in their conditions, and are therefore in a position to take their part in the fierce struggle for existence and success, which, owing to the stress of the present day competition, has become so ordinary an element in our economic environment.

One consequence of the change which has taken place is

that it has become more than ever necessary to prevent, so far as prevention is within the limits of human power, the occurrence of a serious outbreak of fire in a modern dock system, as it can readily be understood that the result of a conflagration would be far reaching to an extent which could not be measured by the monetary loss involved in the destruction of premises and goods, as the injury to the port due to the dislocation and displacement of trade (owing to the destruction of the means of carrying it on) might be permanent and irretrievable; it being obvious that such injury might result in driving into the hands of competitors trade which would be invaluable to the suffering trust, board, or company.

In the matter of fire prevention on dock quays and in dock transit sheds and warehouses the "carpenter" and the "cap" of the aphorism become respectively systematic and take or should take the form—

(1) Of disciplined and vigilant watchfulness.

(2) Of handy appliances by means of which incipient outbreaks may be checked if not absolutely extinguished, these systems being supplemented by a third, by means of which reinforcements, both of men and appliances, can be concentrated at the point of danger with the least possible loss of time.

One concrete example of the manner in which systematic fire prevention may be effected is afforded in the port of Manchester, and at the docks which form the terminus of the Manchester Ship Canal; and it has been suggested to the author by the management of the International Fire Prevention Congress that some account of the system in operation might be of interest to the members of the Congress.

Description of the Estate to Be Protected.

The plans (Fig 1) appended to this paper will serve to convey some idea of the character and extent of the docks in question, when considered together with the following figures:

Area of water space in docks now in use.	104·50	acres.
Area of quay space (excluding sheds and warehouses).....	166·40	"
Area of floor space in sheds.....	44·30	"
Area of floor space in warehouses.....	8·15	"

When dock No. 9, now in course of construction, is completed (probably in July, 1905), the areas given above will be increased by 15·50 acres, 50 acres and 21·60 acres, respectively.

Length of quay frontage in the existing docks. 4 miles.
Length of railway lines on quays..... 39 "

These lengths will be increased by one mile and 14 miles, respectively, when dock No. 9 is completed.

The sheds and warehouses throughout are of solid and substantial construction, brickwork and iron or steel being the materials used therefor; with floors of concrete and asphalt, except in certain exceptional circumstances, where the floors are of wood.

The grain elevator on Trafford Wharf is of special construction, having been built on the American system of timber throughout, but encased with brick and tile work, and having been fitted with special and peculiar means of protection against fire.

Including the elevator, but excluding small offices, shelter huts and boxes, there are within the dock estate altogether 56 buildings, divided as follows:

Transit sheds—Single floor.....	16
Double "	1
Treble "	6
Five "	8
Warehouses—Seven "	13
Grain elevators—and accessories.....	3
Hydraulic engine and boiler-houses.....	2
Electric engine-house.....	1
Traffic offices.....	3
Stores	2
Engineer's workshop and yard.....	1

There are also five distinct storage grounds on which from 80,000 to 90,000 tons of timber are stacked pending the receipt of orders for delivery.

METHOD OF PROTECTION.

(1) Police Force Trained as Fire Brigade.

For the protection of the great estate described in the foregoing, the Manchester Ship Canal Company have, under the power of the Canal Act of 1885, established a force of special constables, the cost of which is a charge upon the revenue of the company, but the members of which (after being sworn in before the magistrates to act as duly qualified constables within the Port of Manchester, and within one mile thereof) are drilled, equipped and uniformed after the manner and in accordance with the regulations of the police force in the city of Manchester (the superintendent in the dock force being, in fact, a superintendent of the city police).

The dock police force is at present constituted as follows, namely:

1 Superintendent,
1 Inspector,
8 Sergeants,
2 Detective Sergeants,
68 Constables,
4 Water Constables,
1 Fireman (at the grain elevator),

making a total of 85 men, who work under the direct supervision of the traffic officers of the company.

The whole of the police are instructed and drilled in the duties of a fire brigade, care being taken that the men are trained in the use and application of the fire appliances provided for them, and that they are fully cognizant of the positions in which these appliances are stored, of the situations of the water hydrants, and of the entrances to the various buildings; as well as of the internal staircases and doors which form the means of communication between the different parts of the same building; the object in view being that should contingency arise or eventuality occur, should for instance fire break out, whether within or without the buildings, each man in the vicinity would be able to find his way to the threatened spot by the nearest available route, and would be able to furnish himself *en route*

with the appliances fitted for dealing with the incipient outbreak.

This object has hitherto been attained in the most complete and satisfactory manner.

The men work in shifts of 8½ hours; there are therefore always 27 or 28 men actually on duty at various points. The extra half hour worked between the eighth and ninth hours represents an overlapping of the shifts, and is for the purpose of allowing the off-going men to compare notes with those who are taking up their duty.

The shifts are divided into individual patrols, the area covered by each patrol varying in accordance with the more or less serious character of the fire risk included in that area, but care is always taken that each man shall remain in communication with his neighbor on either side, so that the sound of his whistle will at any time bring immediate assistance to him.

On the portions of the dock quays where the transit sheds, with their valuable contents, stand, the patrols vary in length from about 150 yards to 433 yards, the average length being about 335 yards; while the men on patrol are supplemented by men in proximity to them who are on fixed point duty, and who are available for the rendering of assistance in any emergency.

The patrols at other parts of the docks are much longer than those at and about the crowded quays and sheds; the general average length covered by each man is thus raised to about 450 yards.

In order to ensure the vigilance and alertness of the men engaged on patrol duty, as well as to increase the sense of confidence of the men themselves by freeing them from any feeling of isolation (an important point during the night hours) a sergeant patrols the whole of the dock system, visiting each constable at least three times in eight hours, and in addition to the sergeant a special constable walks continually round the shed area already referred to, exchanges words with each policeman on his way, and calls at each police cabin and at the dock chief fire station once every hour. This special man, besides being at all times prepared to render assistance where required, becomes the medium of communication between the

men on duty and the fire station, where he reports any circumstance out of the common which may have come under his observation, or of which he may have learned from the constables on patrol.

The system of protection of the sheds, warehouses and quays described in the foregoing paragraphs is supplemented by special arrangements for the protection of the grain elevator against fire risk.

The elevator contains, in addition to a very extensive equipment of machinery for raising, weighing, conveying, distributing and discharging grain, 226 bins varying in capacity from 37 to 300 tons each; it has a total storage capacity of 40,000 tons, and is, as already described, mainly constructed of timber. The whole of the building internally is lighted by electricity, no open light of any kind being allowed therein. Smoking is also strictly prohibited.

A special fireman has been placed in charge of the elevator, whose duty it is to see that the whole of the appliances in the elevator are maintained in perfect order, and that the fire buckets, etc., are kept constantly filled with water. This man is on duty during the day, while during the night two special fire watchmen are employed who take alternate rounds through the elevator and its accessories. It is a condition of service of these watchmen that they should be non-smokers and should regularly attend fire drill.

For the purpose of registering their patrols a detector clock has been fixed in the elevator office, which clock is connected by electric wires with ten different points in the elevator, such points being selected so as to ensure the whole of the building being patrolled. As a watchman passes each of these points he registers, by means of an electric push button, his position and the time of his occupation thereof on a dial in the detector clock; so that a constant check is kept upon his movements, and his watchfulness is ensured.

In addition to the special firemen in the elevator, a number of the men regularly engaged in working the building have been trained in the use of the fire appliances by the fire superintendent and are regularly exercised in such use.

For the further protection of the grain elevator the whole of the buildings, conveyor galleries, towers, etc., have been fitted with a particularly elaborate automatic sprinkler installation of the Grinnell type. During the summer months the installation is worked as a wet system, while from the beginning of November to the end of March the air pumps are used and the installation worked as a dry system, so as to avoid the danger of interference by frost.

It is perhaps unnecessary to add that the immediate detection and early extinction of incipient outbreaks of fire in a dock estate is, after all, but the second line of defense in such estate. The first line of defense is obviously the detection and, so far as this is possible, the abolition of *causes* which might lead to a fire. These causes include the improper use of fires (whether for heating or cooking), and of dangerous lights, the striking of matches, surreptitious smoking, etc., all of which come, in the case of the Manchester Docks, as a matter of course within the cognizance of the firemen on patrol, and in dealing with them, the police powers which the firemen possess as constables are of sensible value and importance.

(2) Provision of Fire Extinguishing Appliances.

In the construction of the quay walls of the Manchester Docks conduits were formed within the lines of those walls above the level of the water and below that of the quay. In these conduits fresh-water pipes have been laid which are four inches in diameter, and which are connected with the Thirlmere and Woodhead systems of the Manchester Corporation.

The water pipes are fitted with hydrants with stand-pipe couplings, by means of which a supply can be drawn from the main at any point and at any time for fire extinguishing purposes.

In addition to the fresh-water mains, hydraulic mains have been laid around the parts of the docks which are situated in the Borough of Salford, that is to say, in the area in which the quays, sheds and warehouses exposed to the most serious fire risks are included. The hydraulic mains (which vary in diameter from seven inches on the trunk quays to five inches on the

jetty quays) are supplied with water at a pressure of 750 lbs. per square inch by two separate hydraulic pumping stations, one at either extremity of the system of mains.

In the hydraulic station at the Mode Wheel Locks, which forms the western extremity of the mains, two sets of triple expansion engines of the vertical inverted cylinder type, and working with steam at a pressure of 160 lbs. per square inch, and with a total I.H.P. of 400, have been established, while in the Trafford Road Station at the eastern extremity of the mains, there are two sets of horizontal compound engines working at a pressure of 100 lbs. per square inch, and having a total I.H.P. of 260.

There are thus four separate sets of engines, each set being capable of working independently of the other three, so that a breakdown of such character as to render the whole hydraulic system inoperative is hardly within the limits of possibility.

The hydraulic mains are fitted with hydrants, with attachments for special hydraulic service pipes, through which the pressure in the mains can be utilized by means of hydraulic ejectors for the extinction of fires.

The hydraulic ejectors (of which ten are available for use when required) form a somewhat special feature of the fire extinguishing appliances employed at the Manchester Docks. Each ejector is mounted upon light wheels, and being itself of small weight, can easily be moved from place to place, and can also be attached in a few seconds to the hydraulic mains; consequently any ejector or number of ejectors can be brought into active use for fire extinction purposes with practically no loss of time.

During the discharge of cotton cargoes, or of cargoes containing any sensible proportion of cotton, an ejector with a special fireman in attendance thereon is stationed at the particular point of the quay where the cargo is being discharged, and is kept in readiness for immediate use by day and by night, with the attachment to the hydraulic main made and the hose pipe coupled up, while under a recent regulation the attendance of the fireman with his ejector has been prolonged so as to cover the whole time in which the cotton may remain in the shed.

By means of the ejectors (the general appearance of which when ready for use is shown in Fig. 2, and the details of the working barrel or hydrant, shown in Fig. 3), the hydraulic pressure in the mains can be employed for forcing water from the docks in practically unlimited quantities to a height well above that of the roofs of the highest buildings on the dock quays, namely those of the seven-story storage warehouses on the quay of Dock No. 8, which are 71 feet above the level of the ground.

The efficiency of the ejectors as fire extinguishing appliances has been acknowledged by all the experts who have seen them at work. Since the introduction of the ejectors at Manchester, the Lancashire and Yorkshire Railway Company have equipped the docks at Fleetwood with similar appliances, and the Corporation of Manchester is about to introduce ejectors of the same type, through which it is proposed that the pressure in the hydraulic power mains in the city should be employed for increasing the pressure of water in the fire hoses when attached to the ordinary mains.

A general list of the fire extinguishing appliances and of the points at which they are kept in store is contained in Appendix No. 2.

The elevator is beyond the area commanded by the hydraulic mains in the conduits of the dock walls, and has therefore been equipped with two special quadruple-acting steam pumps of the Worthington type. One of these steam pumps stands in the engine-house, is automatic in action, and supplies the internal water mains by which the sprinkler system and the hydrants on the various floors are fed; the second pump is erected in a separate house outside the main buildings, and supplies a special circumferential main six inches in diameter, and fitted with hydrants with stand pipe attachments, etc., which has been laid right round the building. By means of the circumferential main and of the corporation main laid in the road adjacent to the elevator, large quantities of water may be forced on to the outside of the buildings or any part thereof, at any time, if fire danger be apprehended or experienced.

In addition to these shore appliances for the extinction of

fire at the Manchester Docks, a fire float has been provided by the company, and has been fitted by the Manchester Corporation with a steam fire-engine which has a pumping capacity of 750 gallons per minute. The float (on which two Manchester firemen are constantly on duty) is moored at a special berth near Trafford Road Swing Bridge, and is but of a temporary character, as a large and exceptionally powerful fire float, which will be self-propelling, will be fitted with all modern improvements and will be capable of pumping 4,000 gallons per minute at a pressure of 120 lbs., is now being provided at the joint expense of the Manchester Corporation and the Canal Company, and will shortly be available for use at any part of the waterway, and on the length of the River Irwell between the Canal Docks and Victoria Bridge.

(3) Means by which Reinforcements can be Concentrated at a Point of Danger.

However efficient the system of fire prevention, detection, and extinction instituted by any dock company may be, and whatever success may be found by experience in the working of the system, it is essential that it should be supplemented by effective means through the use of which reinforcements of both men and appliances can be obtained, at a minimum loss of time, from neighboring fire brigades.

The docks of the Manchester Ship Canal are situated within the respective areas of operation of the powerful brigade of the city of Manchester, and of the smaller brigade in the borough of Salford.

In order to communicate as nearly instantaneously as possible with the headquarters of each of these brigades, a series of fire alarms on what is known as the Gamewell system has been established at the docks.

The fire alarms have been fixed at 15 different points in and about the dock estate.

Results of the Working of the System in Operation at the Manchester Docks.

"The tree is known by its fruit" is an aphorism more ancient and more venerated than that with which this paper

opens, and the fruit of the system initiated at the docks of the Manchester Ship Canal Company may be described in a few words.

For nine and a half years traffic has been carried on at the docks under circumstances which at times become very difficult, and often under extreme pressure; processes of construction for the extension of the works have gone on concurrently with processes of cargo manipulation; great quantities of cotton, one of the most dangerous and difficult kinds of cargo from a fire point of view, have been handled; a network of railways has been operated incessantly; and amidst all this, no single fire worthy of the name has occurred. There have been many alarms and a number of incipient outbreaks, but nothing whatever in the nature of a conflagration.

For instance, in the year 1902, 19 outbreaks of fire were discovered on the dock estate by the constables on patrol, every one of these outbreaks was promptly extinguished, in almost every case the extinction being effected by means of the water in the fire buckets which are provided for such contingencies. On several occasions, sometimes through real apprehension, more often through excessive zeal, alarm has been given to the fire brigades of the corporations, and these brigades have proceeded at once to the docks, but fortunately on no single occasion has it been necessary to call upon them for active assistance, as in every case the outbreak had been caught in time, and wholly extinguished by the men of the Company's own brigade, the fire damage to the buildings on the estate having been *nil*, and that causd to the goods housed in them absolutely trifling.

It seems, therefore, that the claim that the system has been entirely successful can hardly be regarded as unsupported or even exaggerated; and that the satisfaction with which the immunity from fires and from fire damage hitherto enjoyed at the Manchester Docks is viewed by the directors of the Canal Company must be shared by the directors of the great insurance companies in whose offices the buildings and the goods on the estate are insured against fire.

SECTION IV.

THE VALUE OF HAVING PROFESSIONAL REPORTS UPON FIRE, WITH A VIEW TO INSTRUCTING AND EDUCATING THE PUBLIC.

By D. W. Reutlinger, *Editor "Feuer Wasser," Frankfort.*

(Translated from the German.)

When I had the advantage of being an officer of the Bremen Fire Brigade I established the practice of sitting down at my desk as soon as I returned from a fire for the purpose of writing a report for a local journal.

For a technical periodical it is certainly comparatively easy to obtain comparatively correct reports, at least, it is easier for a technical weekly paper than for a daily paper; but just for the reason that it is difficult for a daily paper to obtain true reports, I took care, at the time of which I speak, that the Press should obtain not only suggestions for "copy," but a true and accurate report ready for printing, and it is to urge the importance of such reports that I venture to speak to-day to you, gentlemen, in reference to the kind invitation of the British Fire Prevention Committee.

A technical periodical is not expected to publish a report upon a fire immediately after its occurrence. It has time to collect information, and to get into communication with those persons who have actual and exact information of the event and of all the details connected with it, as well as with other experts, in order to lay before its readers a full dissertation upon the fire and its causes.

Readers are, I venture to think, reasonable enough to prefer receiving a report a little late, if it is true, than to be served promptly with an erroneous and unreliable account.

The circumstances are, however, entirely different with the daily Press. Even in great cities the news of a big fire is

propagated by rumor in a comparatively short time throughout the whole town.

The reader of a daily paper, who may have heard the rumor, confidently expects to find therein a most detailed report of the fire as soon as he takes the paper up. A description of the naked facts does not, as a rule, satisfy him, so that, considering that the reporter generally has not had information about the fire sooner than the readers of this paper, that he has to hurry to the fire and return again, that he has to write his report in great haste so that it may appear in the next edition of his paper, and that the editor of the paper, on his part, leaves no stone unturned to avoid another rival paper forestalling him with news, it is clear that neither the reporter nor the editor are in a position to closely examine the information that they procure before publishing it. At the scene of the fire the reporter has to get his knowledge as well as he can. The firemen, who are the best source of information, being fully occupied at the time, are not available to give information, even if the causes and full circumstances of the fire were known to them, and if they were permitted to speak, and therefore only in very rare cases would a fireman be in a position to give to a representative of the Press on the spot true and exhaustive information as to the causes and circumstances of the fire.

The reporter, then, must turn to the occupiers of the property, who have not always an interest in telling the exact truth, even supposing that they know it, and are inclined to be communicative.

The spectators, on the other hand, are, as a rule, very liberal in their observations, but it is impossible to prove the information thus acquired, and it is moreover impossible to test the reliability of the persons volunteering information. Thus it happens, one might say almost daily, that a multitude of inaccurate reports on fires are spread abroad which contain many inaccuracies liable to do harm by reason of the fact that they are generally read without any critical examination, and accepted as true accounts of what they purport to relate.

The incorrect reports of lamp explosions conduce to wrong conclusions as to their causes and to the proposal of erroneous and useless measures for avoiding them. A higher flash point is demanded, although nothing will be attained by it. One should strive rather to invent means for preventing a lamp upsetting or falling from the ceiling, and endeavor to make the upsetting or falling of the lamp less dangerous by preventing the oil, for example, flowing out on the lamp as it falls down.

I have mentioned lamp explosions only as a typical case where erroneous and inaccurate reports are notoriously made, but I could mention others did the time at my disposition permit of further elaboration. The moral of the example, however, is to be found in the absence of warnings against badly hung, badly fitted, or badly handled lamps not being given to the public, who, thinking of the "explosion," are not reminded of matters of detail by which such accident could be avoided.

Gentlemen, to satisfy the demand for the better instruction of the public as to danger from fire through technical reports on fires, there are only two feasible alternatives:

Either the fire reporters should turn into firemen or the firemen into reporters.

A third way has, however, been tried in Hanover, which I shall mention first.

In a special room of the fire brigade's headquarters are kept record books, in which the fire brigade officers enter their notes on fires, accidents, and so forth, and newspaper reporters are allowed to see these record books. I do not think that this plan is a feasible one, as the procedure is too circumstantial, too troublesome, and occupies too much time.

It is, however, quite different with the other two ways, although the following points must be considered:

For a fire reporter to turn himself practically into a fireman he must have an inclination for this special kind of work, study his subject and obtain the necessary facilities for getting to the fire. One such case is known to me.

The editor of a journal published at Dresden employs a

reporter who shows a very keen interest in everything connected with fire extinguishing. He writes detailed and good reports of fires, being always in close communication with the staff of the chief of the fire brigade of the town. But this is an exceptional man and an exceptional case where exceptional facilities are granted, and so I arrive at the conclusion of recommending the second course I have mentioned, and advising fire chiefs and their officers to take up the pen themselves, to prepare the " copy " for the local fire reporter.

This course offers considerable advantages. He who writes for the public exposes himself to the danger of criticism. Hence he must learn to see correctly and quickly, but nevertheless impartially and carefully. This is an excellent apprenticeship for the officer, inasmuch as a considerable amount of thought and reasoning is required to be able to deal correctly and instructively in every different case. The officer is therefore forced to acquire a knowledge of and an appreciation for every technical department concerned, whether it relates to prevention or fighting, and in so doing he will certainly not suffer any detriment in his calling. By preparing the MSS. himself he can further influence the public in the direction he would wish them to go in matters of fire protection, and, if he is a good chief, he will do his community unanswerable good.

I now beg to close my observations with the following deductions:

1. I consider it advisable that newspapers should offer to the public technical reports on fires of such a nature that their readers may be in a position to benefit from the special knowledge and experience gained at important fires.

2. I consider it desirable that technical reports on fires should be prepared for the newspapers by fire brigade officers themselves, if they are really to be instructive and serve both as a guide and as a warning to the community at large.

I will not go so far as to embody both deductions into a resolution, but I will go so far as to propose the following in general terms and ask your acquiescence:

Resolution.

The Congress considers it advisable that the Press should from time to time publish technical reports on fires, so that the public may benefit from the knowledge and experience gained.

Resolution adopted.

SECTION IV.

THE CARE OF PRIVATE FIRE APPLIANCES, FROM AN AMERICAN INSURANCE POINT OF VIEW.

By Gorham Dana, *The Underwriters' Bureau of New England and Boston, U. S. A.*

Fifty years ago, when private fire protection depended on fire buckets, augmented occasionally by standpipes connected to small pumps, the care of private fire appliances was a simple matter. Anyone with ordinary intelligence knew how to care for a pail and how to use it when needed. Within the last half-century, however, developments have taken place in methods of fighting fire so revolutionary that to-day it requires men especially trained for the purpose to care for and to use the modern fire appliances such as are found in large manufacturing plants, department stores, theatres, and the like. While the inventor has been busy perfecting automatic sprinklers, dry valves, alarm valves, underwriter steam pumps, automatic regulators, thermostats, chemical extinguishers, and many other devices, the underwriter has been at work making rules for the installation of the same. In America, largely through the efforts of the National Fire Protection Association, these rules have been perfected and unified at great expense of time and money, so that to-day there are national rules covering the construction and installation of almost every fire-protecting device of importance on the market.

The underwriter has kept abreast of this development and has, indeed, been largely instrumental in the progress made. He has been quick to realize the importance of new devices and to give them due credit in rating.

But has the mill owner and the factory superintendent, the theatre and store manager done his share in developing modern protection? Has he been willing to investigate and test new

devices? Has he been willing to install such devices even after their value has been proved, except when a considerable reduction in rate has been offered? I believe that as a rule he has not. Again, has he instructed his helpers in the use of apparatus after it was put in, and has he taken means to see that it is kept in order at all times? In short, has the care of fire appliances kept pace with their development? Our experience in New England shows that it has not. To find sprinkler valves shut, pumps out of order, tanks empty, fire doors broken and thermostats crippled is an almost daily occurrence.

The chief desire of a large class of property owners seems to be to get the device installed to the satisfaction of the underwriters, so that they can get their promised reduction in rate, and then to let the costly and complicated apparatus take care of itself.

Others seem to consider it necessary to economize in the care of fire appliances by hiring cheap, incompetent men, as watchmen and mechanics, by not keeping up steam at all times for their pumps, and by not spending the necessary money on repairs. Are not fire protection devices as important as other machines that they are thus neglected? When needed they are the most important machine in the mill, and they are liable to be needed at any minute.

Another class of managers may be credited with a conscientious desire to keep their fire appliances in order, but through carelessness and oversight, due to the press of other business, they allow them to become neglected. Few managers apply the same business principles to the care of their fire appliances that they do to other departments of their business.

Many men who have never had a fire in their plant fail to realize the importance of good fire protection, and take but little interest in the subject. Such men are very apt to fall back on their fire record and think that they have a fine risk, and that modern appliances are quite unnecessary. Experience, however, is a great teacher, and after a baptism of fire such men look on the matter through different eyes, and are not

only willing but anxious to have good protection, and to keep their apparatus in order.

But fire is a costly teacher, and one hardly to be recommended. The assured must be educated in a simpler and less expensive manner.

A large number of the serious fires in sprinklered risks in America during the last few years may be attributed to fire appliances being out of order, due to defective care. Tanks empty, pumps out of order or without steam supply, alarm-giving devices out of order, and closed supply valves account for most of them.

Ineffective use of appliances, due to unfamiliarity with them and ignorance, is also an important factor in many fires. Occasionally we find a plant where all the employees are carefully instructed as to the use of fire appliances, and are assigned certain duties in case of fire. In some of the large department stores, where a large number of lives, as well as large values, are at stake, complete instructions and description of devices are issued in pamphlet form and given to all employees.

In the majority of plants, however, most of the employees know little or nothing about the fire appliances, and in case of fire either waste a great deal of time and work to poor advantage, or else lose their heads entirely and accomplish nothing.

Fire appliances are emergency devices, and are not kept in order through constant use, as are most appliances in a mill. The only way to care for such emergency devises is by systematic inspection. How and by whom shall these systematic inspections be made? There have been attempts made to solve this problem in several different ways.

1. Inspections by the company installing the device.

In Russia sprinkler equipments are regularly inspected by a corps of inspectors, employed by the contractor who puts in the system. In America, especially in the large cities, it is customary to have automatic thermostat systems cared for by the company that installs them.

This system of caring for fire appliances is not, however, without its faults, among which may be mentioned the following:

(*a*) It would require a separate set of inspectors for each kind of device installed. Thus there might be a set of inspectors for sprinkler systems, another for thermostat systems, another for pumps, and so on. This would, in some cases, make a great number of inspections during the year. There are certain minor devices, like chemical extinguishers, which it would hardly pay to send a special man to inspect, and as a result under this system they would never be tested or inspected.

(*b*) Such a system would also tend toward preventing the assured from becoming familiar with their appliances, and taking off their shoulders all responsibility in case anything was out of order when needed.

(*c*) Such inspectors could not as a rule make frequent enough inspections to give the best results. The best that could be hoped for would be monthly or quarterly inspections. This is entirely inadequate, especially for such delicate apparatus as thermostats where daily inspections are none to frequent.

(*d*) The cost of such a system is considerable and falls directly on the assured. Of course, the expense falls finally on the assured under any system; but where it falls indirectly, as in the case of bureaus supported by the insurance companies, the expense is not realized. Direct taxation is never popular.

In defense of this system it may be said that inspectors hired by contractors are more apt to understand the device thoroughly than others; they also have a certain pride in seeing that it does its work properly when called upon, and are (or should be) men who are able to repair the apparatus on the spot in case it is found out of order.

2. Inspection by bureaus supported by the insurance interest is the second method of solving the problem. This method is very common in America, and is carried on over almost the entire country for the most valuable and best-equipped plants.

Here again we find the defect of too infrequent inspections. In some of the large cities regular inspections are made every month, but once in three or four months is the general rule. It becomes too much of a financial burden for the insurance companies when inspections are made much more frequently.

On the other hand, the work is done more cheaply than by the previous method, for one inspector now does the work of several and requires but little more time for his inspection. He is also unprejudiced, and looks out merely for the interest of his companies, namely, the prevention of a fire if possible and its control with the least possible loss if it does occur. Such an inspector not only looks after the fire appliances, but also investigates hazards, and offers suggestions for improvements that undoubtedly result in greatly lessening the fire waste.

3. Inspection by the assured is found in some of the largest and best managed plants in America. Some competent man is instructed to make a complete inspection of the plant once a week, to test or examine all fire appliances, and to make a written report of the condition of same. This is handed to the manager or superintendent, who looks it over and then files it away for reference. By this method nothing can be out of order over a week without the manager knowing about it. Occasionally this system of self-inspection is carried to the point of making daily inspections, especially of vital features like supply valves on sprinkler systems.

The blank used for this purpose will vary with each risk, but there are certain important features common to all plants. In our territory we have a general blank printed which covers all important features that are likely to be met with. This blank is corrected or added to to apply to any particular risk, and a copy is then sent to the assured, which they can use as a basis for a special printed blank.

Note.—Samples of the general blank and of particular special blanks used in particular places are shown.

This scheme of self-inspection if properly carried out is certainly the ideal method of caring for fire appliances, but in practice it falls far below the ideal. The man detailed to make the inspections, unless he be a very exceptional man, is too apt to do the work in a perfunctory manner. He will report a device in good order without actually testing to see that it is so. It is far easier to enter O. K. on the blank than to actually test a pump, for instance. Some check is needed on the average man, and, indeed, on the best man, for no one is infallible.

This might be obtained by having a second employee make the inspections occasionally. Even then there is a chance of collusion between the two men, in case something is out of order that reflects on the proper performance of their own duty. There is also a chance that both will be careless.

The system has the great advantage of frequent inspections which it is impracticable to obtain by either of the other systems mentioned.

It will be seen that each of the systems has its defects. How, then, are we to get satisfactory results? There seems to be but one answer to the question. It will be noticed that the same defects do not exist in all the systems, therefore a combination of the three ought to eliminate the defects.

A thorough and systematic inspection by the assured, conscientiously carried out, occasional inspections by trained surveyors from the insurance companies, and in case of complicated devices that require expert care, regular inspection by the company that installs them: these three combined should give the desired result.

In conclusion, it may be of interest to give a short description of a plant where this combined system is found in a high state of development.

The Grand Trunk Railway terminal property at Portland, Maine, is an excellent example. This property has an insurable value at some times of the year of over 5,000,000 dollars, and fire protection costing nearly 80,000 dollars has recently been installed to protect it.

There are two large grain elevators, one of a capacity of 1,500,000 bushels and the other of 1,000,000 bushels. Each elevator has its own power plant. There are eight large dock sheds, divided into three groups, each group having a floor area of approximately 10,000 square feet. An elaborate system of covered grain conveyors extend from the elevators to the docks. In addition there is a passenger station, freight station, and administration building.

The grain elevators are completely equipped with automatic sprinklers, supplied by two pressure tanks in the top floor of each, and by two 1,000 gallon automatic steam pumps in a fire-

proof pumphouse in the yard. There is also a 500 gallon steam pump at each engine-room, which can be used as a sprinkler supply. The sprinklers are piped with extra large pipe sizes, and are on the dry system. The equipment is divided so that there is only approximately 200 heads on a dry valve. This requires eight dry valves in one and seven in the other elevator. Each dry valve is connected to a rotary alarm bell, and also to an electric bell and annunciator in the engine-room.

There is a yard system of nine hydrants, supplied by city water under 60-pound pressure. These are fed by a 10-inch loop connected to an 8-inch and a 12-inch street main, and are primarily for steamer supply. The city pressure would not reach to the top of the elevators, which are 175 and 160 feet high respectively. There is a second hydrant system supplied by the pumps, and this is under 100 pound pressure at all times. These hydrants are fitted with standard hose-houses containing 250 feet of hose and other equipment.

All journal bearings of any importance are equipped with solder release journal bearing thermostats. These are connected to electric bell and annunciator in their engine-house, and in case any bearing reaches a temperature of over 165 degrees an alarm is given at this point. There is also a system of manual alarms located throughout the docks and elevators, connected to gongs and annunciators in each engine-house.

The grain conveyors are equipped with sprinklers where they adjoin the elevators, and for a distance of about 200 feet beyond. The docks contain a system of monitor nozzles, 36 in all, located about 120 feet apart. They have an outlet of 1½ inches, are set up about 5 feet above the floor, and are supplied by the pumps under 100-pound pressure.

In the grain conveyors there are two fire stops, one consisting of a fireproof section 90 feet long, with a tin-covered partition at each end. There is also a wire cable hung at a conspicuous place on one elevator to be used in wrecking the conveyors in case of fire. This is done by passing it around two of the supporting posts and attaching it to a locomotive.

The electric circuits of the alarm system, the journal bearing thermostat system, and the manual alarm system all have

testing devices whereby every foot of wire can be tested daily, and a record kept of same.

There is a private fire department of twelve men, who drill weekly. The chief of this department is hired for the express purpose of caring for the complicated fire appliances, and this is his whole duty. He makes a daily inspection of all appliances, and a report on same which covers three large pages. These reports, together with the watchman's dials (the dials giving a record of four sets of electric tests), and the automatic steam pressure gauge dials are all examined daily, and kept on file by the agent.

The plant is also inspected at least four times a year by an insurance inspector, who, as a rule, spends one and a half to two days in making his inspection. He also looks over the records above refered to, and checks them up.

As a result of this admirable system, the fire appliances are kept in as perfect condition as could be desired. Several fires have already been extinguished with but little loss—one a dock fire among cotton bales that would undoubtedly have destroyed a third of the dock property at least, were it not for the protection devices and the excellent organization to handle them.

May we not hope that equipments of this kind may be the rule instead of the exception at some time? It is certainly the goal toward which we should all strive.

SAMPLES OF REPORT BLANKS.

APPENDIX I.

GRAND TRUNK RAILWAY SYSTEM.

FIRE PROTECTION APPLIANCES, STEAMSHIP DOCK SHEDS AND ELEVATORS AT PORTLAND, MAINE.

INSPECTOR'S DAILY REPORT.

1. VALVES (Inside Gates).

Note—All gate valves to be secured open and sealed. Each valve to be inspected by turning valve one half-turn to ensure its being wide open and in good working order. Drip valves to be sealed closed in a similar manner.

LIST OF VALVES.

No.	Location.	Open-Sealed.
1.	Controlling dry system 1, elev. No. 2	.....
2.	" " 2, " " 2	.....
3-7.	" " 3-7, " " 2	.....
8.	Tank valve under No. 1, or west tank No. 2	.....
9.	" " " " 2, or east tank " 2	.....
10.	Sprinklers, engine and boiler-room " 2	.....
11.	On pump discharge, engine-room " 2	.....
12.	On pump suction, " " 2	.....
13.	Pump discharge on No. 1, or north 1,000 gal. pump	..
14.	" " " 2, or south 1,000 "	..
15.	On 10-inch discharge from both 1,000 gal. pump	....
1.	Controlling dry system 1, elev. No. 3	.....
2.	" " 2, " " 3	.....
3-8.	" " 3-8, " " 3	.....
9.	Under tank 1 (west), in No. 3 elevator	.....
10.	" 2 (east), " 3 "	.....
11.	Discharge on pump, engine-room No. 3	.....
12.	Suction on pump, engine-room No. 3	.....
13.	Sprinklers in engine and boiler-room No. 3	.....

2. VALVES (Outside post indicator gates ordinarily kept open).

Note—All P. I. G. valves to be fitted with hand wheels or socket wrench permanently secured to spindle. To be secured and inspected in the same way as inside valves.

LIST OF VALVES.

No.	Location.	Open-Sealed.
12.	Controlling sprinklers in elevator No. 2	.....
14.	" suction of pump, engine-room No. 2	.....
15.	" sprinklers in elevator No. 3	.....
16.	" suction of pump, engine-room No. 3	....
17.	" discharge to pump, " " 3	....

3. Give numbers of any valves found closed, part closed, not sealed, closed temporarily at any time since last inspection .....Explanation .....

4. DRY SYSTEMS (Air Valves).

Pressures to each to be recorded after the valve number.

LIST OF VALVES.

No.	Location.	Air Pressure, lbs.
1.	In elevator No. 2	.....
2-7.	" " 2	.....
1.	" " 3	.....
2-7.	" " 3	.....

5. Give number of any air system into which water has entered during the day.....Explanation.....

6. Tests of electric circuit to be made daily and records kept on file .....

Manuals, elevator No. 2, condition.....

" " " 3, " .....

" dock sheds, " .....

Thermostats journal alarms, elevator No. 2, condition.

" " " " " 3, " .

Watchmen's time indicators, " " 2, " .

" " " " " 3, " .

" " " dock sheds, " .

7. *Note*—Rotary bells to be tested monthly. All controlling valves to cocks for alarm devices to be sealed in the same manner as inside valves. If cock is open and sealed, place check against number.

No.	Location.	
1.	Elevator No.	2.....
2-7.	" "	2.....
1.	" "	3.....
2-7.	" "	3.....

8. Give numbers of any alarm devices out of service.....
Explanation .....

9. PRESSURE TANKS. Air pressure. Water level.
Tank at No. 2 (east).....
" " 2 (west).....
" " 3 (east).....
" " 3 (west).....

10. STEAM PUMPS. Condition.....
Note—Pumps should be given a thorough test with rated number of hose streams at least twice a year, spring and fall. Valves in steam connection from boilers to pump wide open.....

11. AUTOMATIC REGULATOR.
Regulator controlling valves wide open.....
Pressure maintained.....Pump started and regulator operated at.....lbs. Which pump is automatic?.....Steam pressure maintained .....Steam pressure must not be less than 60 lbs.

12. AUTOMATIC SPRINKLERS.
Any corroded, bent, whitewashed, gilded or painted, covered with dirt or grease, obstructed by storage clothing, partitions, shaft hangers.....

13. Is there a clear space of at least 2 feet below level of sprinklers, free from storage or other obstruction. Note any exceptions .....

14. FIRE BARRELS AND PAILS. In place.....Full.....

15. FIRE DOORS.
Closed and fastened nights, Sunday and holidays, and all times when not in use.....Will all fire-doors

close easily?.....
Note any fire-doors in need of repairs.....
Automatic attachments in order.....

16. HOSE PLAY PIPES AND SPANNERS.

In their proper place and ready for use.....
Condition.....Hydrant house not obstructed.....Hose house No. 1.....
House No. 2.....House No. 3.....

17. ELEVATOR AND STAIR DOORS OR TRAPS.

In order and kept closed when not in use. Note any exceptions .....
Condition of latches or other hardware.....

18. CLEANLINESS.

Oily waste well cared for.....Basements clean.....
Yard kept free from combustible material.....
Belt enclosures clean.....Clothes closets and water-closets clean.....Shafting and bearings well cared for.....Clean under benches.....
Note any possible improvements in cleanliness.....

19. MONITOR NOZZLES. DOCK SHEDS.

Each nozzle to have handle moved slightly so as to insure that it is in good working order. Also open and close gate valve slightly and note whether space around nozzle is sufficiently free from storage so as to not unduly obstruct the stream.

No.	Condition.	Gate Valve.	Unobstructed.
1.	.....		
2-36.	.....		

20. POST INDICATOR GATE VALVES CONTROLLING MONITOR NOZZLES AND PRIVATE SYSTEM.

These gates to be given a half turn to insure that they will work easily.

No.	Condition.
1.	.....
2-13.	.....

REMARKS.

.....

Report to be made daily and filed with the Agent.

Date..... .....Inspector.

Appendix II.

THE J. B. WILLIAMS CO., GLASTONBURY, CONN.

WEEKLY FIRE INSPECTION REPORT.

INSIDE VALVES:

Check No.	Location.
1	Basement of No. 1 Mill, south end.
2	" " " 1 " to open passway.
3	" " Drying " west end.
4	" " No. 2 Mill, south end.
5	" " " 2 " to carpenter shop.
6	" " " 4 " north end.
7	" " " 5 " east end.
8	" " " 5 " " " to boiler-room.
9	" " " 5 " under tank.
10	" " " 5 " in fire pump delivery.
11	" " " 5 " " " " suction.

Valves checked above have been examined, found strapped and tag marked; also have been turned ½ revolution.

Numbers of any not properly tagged and dated. ——.

Reason. ——.

Numbers of any found closed. Nos. 2 and 5.

Reason. No. 2, dry system, always closed. No. 5, closed in cold weather.

Numbers of any not strapped. 2 and 5, also 3 and 8.

Reason. 2 and 5 as above, 3 and 8 need new straps.

Numbers of any not examined. ——.

Reason. ——.

INDICATOR POSTS:

Check.	No.	Location.
	1	In supply to No. 1.
	2	" " " " 2.
	3	" " " " 4.
	4	" " " Drying Mill.
	5	" " " No. 5.
	6	" " " " 6.

Numbers checked above have been examined, found open, and have been turned back 3 revolutions. Also wrenches noted in adjacent hose houses.

Numbers of any found closed. ——.

Reason. ——.

Numbers of any not examined. ——.

Reason. ——.

HOSE HOUSES:

Check.	No.	Location.	
	1	South of Mill No. 1.	2 ladder hooks put in No. 3.
	2	North " " " 1.	
	3	West " " " 5.	1 crowbar in No. 1 and No. 5.
	4	North " " " 5.	
	5	East " " " 2.	
	6	South " " " 6.	

Numbers checked above have been examined and found to contain 100 feet rubber lined hose, 50–100 feet linen hose, 4 spanners, 1 wrench, 2 nozzles, 1 axe, 1 lantern.

Any exceptions to above condition? No. 1, no axe. No. 6, one nozzle only.

Reason. Both have been lost in some way.

What hose has been thoroughly aired and drained? ——.

Any hose tested? Three lengths linen rejected on account of couplings not fitting, and taken out of hose houses.

GRAVITY TANK:

Full? Yes. Contents frozen? No. Telltale in order? Yes.

FIRE PUMP:

Has pump been started during the week? Yes, 2/3/02.

If not, state reason.

Apparent condition. Good.

Has pump been tested? No.

If so, how and with what results? ——

Is supply of oil kept in pump-room? No.

AUTOMATIC SPRINKLERS:

Any corroded? Awaiting result of tests.

Covered with dust or dirt? Orders given to brush once a week in No. 5.

Obstructed by clothing or stock placed too near? Not that can be avoided.

FIRE PAIL AND EXTINGUISHERS:

Mill No.	Amount of Water in Pails.	Any Missing.
1.	Good—Freshly filled	No.
2.	" " "	"
3.	" " "	"
4.	" " "	"
5.	" " "	"
6.	" " "	"
Drying Mill.	" " "	"

Number of extinguishers discharged and refilled, and tags dated. Nos. 1 and 2.

FIRE DOORS:

Do automatic doors in No. 6 run easily? Yes.

Do automatic doors at pump-room run easily? Yes.

Number of these found open when inspected after 6 o'clock at least once last week? Four.

Reason. To let heat into tower.

Do all doors at stairways in Ivorine Mill close and fasten properly? Yes.

Corresponding doors in No. 1 and No. 2 mills? Yes.

Number of these found open at evening inspection as above? Nearly all.

Reason. To let warm air circulate.

FIRE PRACTICE:

When was last fire practice held? Before cold weather.

What did it consist of? Ordinary hydrant streams until water ran clear, five to ten minues.

RESERVOIR:

General condition of? Excellent, when last inspected.

Pressure 82½ lbs. static.

Date of inspection? February 4, 1902.

Made by P. K. Williams.

Discussion.

Lieut.-Col. Fox, F. R. G. S. (Chief Officer, London Salvage Corps), said:

Mr. Chairman and Gentlemen—I feel very keenly on this subject of fire appliances, and, with your kind approval, I should like to say a few words in support of the paper which I have had the pleasure of reading, though I have not had the pleasure of hearing it read. Fire insurance companies are constantly urged to give rebates from the premiums for certain fire appliances which are placed in the buildings which they insure; and I can assure you, speaking as I do with some experience of the matter, in certainly seven cases out of ten, if unexpected visits are paid to those establishments and public buildings the fire appliances will be found in a rotten condition, and very often badly out of order. I do not speak entirely from a fire insurance point of view, but I think there is nothing more dangerous than to have hoses, axes, helmets and other things stuck about the walls of a public building if they are not in an effective condition. Fire insurance companies are constantly asked, as I said before, to give these rebates, and people who erect buildings, or the owners, or occupiers, think it is sufficient to stick these mural decorations about the place; I say mural decorations advisedly, because they are nothing else. They are of no use except in the hands of a man who is trained to use them, and until some system of inspection is insisted on I shall recommend my own offices not to grant these rebates. It is really encouraging a danger, because owners of property are under the impression that because those things are there they are protected, and they are not. Very often there is another danger, namely, the so-called "fireman." A man takes charge who has been in some fire brigade, and seen one fire in two years, perhaps, and he gets an appointment in a large warehouse, and directly he sees smoke he shows a clean pair of heels. That is a very great danger. We must all be greatly indebted to Mr. Gorham Dana for the excellent paper with which he has provided the Congress.

Rebate on Insurance for Private Fire Apparatus.

Danger from Inexperienced Firemen.

Mr. T. F. BRITTON (Inspector, Gas, Water and Fire Services, London General Omnibus Co., Ltd.)—May I say a word in corroboration of Col. Fox? I quite concur in what he said. There are a number of persons intrusted with very valuable property; they have no idea as to water pressure, or anything else. I have been surprised to go into theatres which are supposed to be looked after. If they have a certain pressure they have only a 3-inch main, which will only supply one hydrant on the ground floor, and then it is hardly an effective one in nine cases out of ten. The men intrusted with these appliances, as Col. Fox says, have the implicit confidence of their employers, and are more a snare than otherwise. If a fire came there, they would simply give the call, and give people about to understand that they were going too. In my idea, a private fireman ought to be a man who is sufficiently trained as a musician should be, so that he can feel his keys before he attempts to play. He has quite sufficient to do to deal with the risks about him, and his hands must fall on the right gear at once, and with a glance he must see what is going on. If a man has not that training, as the Lieut.-Colonel says, he is going to lose his head. He must be accustomed to smoke, too; in a fire smoke is like blood, it makes a big show, and (I think the Chief Officer of the Salvage Corps will bear me out) sometimes the fiercest fires are the most superficial. They will frighten an inexperienced man, who will do more damage by his water than the fire will. The old rule was never to get our big gear to work until we found it absolutely necessary; and it was astonishing what those hand pumps did. Now we have advanced a stage or two; we have got our chemical engines, and, in the first stages, these chemical extinguishers do a great deal of good, not only from the action of the chemicals on the fire, but from the impact; the chemicals give the power, and you do not require the relays of men; one man can do so much more than several men could with the hose. If we insist on having men who know how to deal with the matter, and how to look for fire, and prevent fire, I am quite sure we shall have the

support of the Chief Officer of the Salvage Corps in asking the insurance companies to grant rebate of premiums.

RESOLUTION.

The Congress considered that greater attention should be accorded to the maintenance of private fire appliances where installed to meet local or insurance requirements.

This was carried unanimously.

SECTION IV.

FIRE SURVEY AND FIRE WATCHES IN THEATRES DURING THE PERFORMANCE.

By Chief Officer Goldoni, *Fire Brigade, Milan.*

(Summarized Translation from the Italian.)

It often happens that even experts, in the application of the simplest and best-known rules, meet with difficulties in the execution of their duty.

As chief of a fire brigade, governed by clear and well understood laws, I have nevertheless frequently had to fight against obstacles thrown in my way by the managers of theatres, who, either from motives of economy or from a feeling of independence, could with difficulty endure the vigilant interest accorded them by my force.

All that I am about to say is in no way new to experts, but I very much desire to have your assurance that in accordance with my views the protection of theatres from fire may, in some cases, receive greater attention.

This service of continual vigilance in theatres during representations, the necessity of which is now everywhere admitted, may become of double importance in cases where the various constructional and other rules recommended for the safety of theatres and public halls have not been rigorously applied.

* * *

Arrangements for fire watches are different in different localities. They are intrusted:

(1) To people who have not only no knowledge whatever of such duties, but whom the management, at the same time, intrusts with other duties also.

(2) To persons paid expressly for this purpose, and who are exclusively dependent on the managers of the theatres.

(3) To the fire brigade or such section of it as is already employed in the public service for the prevention and extinguishing of fires in the city where the theatre may be.

In the first two cases the apparatus and equipment necessary for coping with a fire always belongs to the management of the theatre.

In the third case, as I will show later, it may happen that the public authority takes on itself to provide them.

In my own city, for example, it is the Town Council that provides all that is necessary for this service.

* * *

First Case: The persons to whom the safety of the theatre is entrusted are at the same time charged with other duties.

All the considerations that I am about to express assuredly tend to show that it is neither just nor equitable to charge the public funds with the expense of watching theatres and public halls. I admit that this may happen perhaps in the case of a theatre of great artistic renown in which public interest is engaged, so to speak, but it should absolutely not occur in the general case of theatrical managements having no other object than that of their own personal interest and profit.

The principal preoccupation of theatrical agencies is to spend as little as possible on fire watches. We have, they say, a good number of people employed as scene-shifters, mechanics, doorkeepers, to whom, should occasion arise, we entrust the task of working suitable apparatus for extinguishing fires.

Experience has shown how many unforeseen incidents arise in a theatre at the moment of danger, and consequently all confusion of duties should be avoided. It is for this reason that the staff, whose business it is to open the emergency doors, should only have to think of properly directing and facilitating the egress of the public; that also the mechanics should only have to attend to matters with which they are familiar, and so on.

* * *

Coming back to the second case, that of persons expressly employed to watch and take precautions, who are paid

for this sole object and are entirely dependent on the theatrical management, I can affirm—from information received from my colleagues, and from my own experience—that this plan has not given good results.

A very small proportion of the persons employed are old firemen, and the rest are people to whom they have given a hasty training, and on whom, consequently, but little reliance can be placed. The more so, because not being accustomed to maneuver at a fire, they may be seized with panic when face to face with one.

I have had proof on frequent occasions that these same old retired firemen, who were our companions in work, when once out of service are generally found wanting in that energy and promptness which are so necessary in moments of danger.

Danger from Careless Special Firemen.

The occupation of watchman in the theatres is a charge of the highest importance, but at the same time monotonous and wearying—little as it may appear to be so; at the moment of danger it is necessary that assistance be rendered promptly and quickly, and that the resolute demeanor of the theatrical fire watch should dominate the frightful alarm that may take possession both of the actors and the public. Now, among these retired firemen, however courageously they may have braved all kinds of danger, is seldom to be found one who still possesses the perseverance requisite to resist the monotony and dreariness of such an occupation.

As regards the others, casually employed and taken on for a special occasion, it is not by the occasional exercise of badly devised sham drills that one can expect to make capable and reliable firemen.

In short, in the first case as in the second, I have been able to observe how carelessness increases by degrees, owing perhaps to the influence of a wearying occupation, and perhaps even to the state of indifference of the theatrical managers towards all that concerns measures of safety.

* * *

Fire Watchers should be Regular Firemen.

As to fire watchers detached from the local regular fire service, I would say as follows: To make a good fireman it is

necessary that besides a natural aptitude he should possess a certain amount of education, and to keep him good, continual practice is highly necessary.

A quiet, stolid self-possession and a steady confidence in his own strength and in the means at his command, are only to be acquired by long experience with fires. It is only then that a fireman can be competent to distinguish between apparent and real danger, to estimate promptly and almost instinctively the real extent of it, and to provide for it instantly by the most suitable and proportionate means.

Thus "cuirassed," so to speak, the fireman need never fear attacks of panic, so fatal in cases of fire. This is the important and necessary quality required in those appointed to exercise vigilance in theatres.

An inexpert fireman may on occasion be the cause of the gravst consequences; he may increase the fear in the public mind; he may, in fact, by his inexperience be even the determining cause of it, as, for example, in the case of a simple commencement of fire, by using a strong head of water and inundating the stage and side-scenes, when a wet sponge or a small spray from a hand-pump would be sufficient.

Now, all these necessary conditions of ability and practical experience combined cannot be found in any but those who are continually drilled and in daily practice, like the firemen employed in the public service.

As concerns the way in which vigilance should be exercised, it is almost superfluous to say that the firemen should be distributed in the handiest possible way—on the stage, in the flies, under the stage, on the scaffoldings. The plan of keeping them together in the guard-room should be abolished, with the view of avoiding unfortunate consequences, because at the moment of need the sudden arrival of a compact body of firemen would have the effect of augmenting the alarm of the actors and of the public, and so render more difficult the saving of both property and life.

In the large theatres where the requirements may be very numerous, it is most useful to keep a small reserve always ready in a special room, so as to be able also to give

first aid in cases of fainting or other ailments such as frequently occur in all places where there is a great crowd.

I claim that the firemen placed to watch the theatres should stand ready fully equipped with helmet and necessary implements; only those in the galleries where the machinists work being allowed to sit; it is for this reason that I interchange the firemen—those on the stage and under-stage with those of the galleries—so that all may enjoy a few moments' rest.

Fires in Milan Theatres.

At Milan, my native city, in certain theatres which are not fully provided with the means of safety, from the year 1892 to 1900, during the substitution of electric light for gas, there were about twenty outbreaks of fire immediately extinguished without causing alarm among the public, and it appears to me that this example proves the soundness of this method.

Other advantages show the necessity of entrusting the care of the theatres to those already employed in the public service for the prevention and extinction of fires, such as:

Changing Posts of Duty.

(1) The general service of prevention derives its complete success from the fact that the firemen being sent alternately to the different theatres of the city are thus able to become acquainted with the "run" of the different buildings —often very complicated—and consequently are always ready with ways of escape in case of fire.

(2) This "safety service" at theatres, taken really seriously, offers the most solid guarantee, and to a great extent removes likelihood of error.

(3) A continual and active control procures the most severe discipline and the most exact observance of rules and directions.

* * *

Of the apparatus for extinction, we must discriminate:

(*a*) Fixed apparatus, composed of the water service at high pressure, tanks, sprinklers, electric pumps, etc.

(*b*) Movable apparatus composed of hose, small hand-pumps, fire extinguishers, buckets, sponges, harpoons, etc.

All the fixed apparatus generally belongs to the theatrical

management and forms an integral part of the building with its special theatrical uses, and it is well that its arrangement should be made on technical principles, so as to offer in case of need the most timely and numerous resources.

Movable Apparatus should be City Property.

As regards the movable apparatus, I have frequently had occasion to establish by convincing proof the fact that this should be public property; that is to say, that those who have the superintendence of the fire service ought to furnish it. In Milan, until the year 1902, all the movable apparatus was the property of the theatrical management; but it happened that whenever it became necessary to make a request for repairing any article, such request gave rise frequently to complaints, and sometimes met with determined opposition.

I have had many and many a time, in face of the grave responsibility devolving on me, to provide apparatus belonging to the brigade in place of hose so deteriorated as not to withstand the pressure, or of fire extinguishers, or small pumps which no longer worked properly.

Add to this that the persons employed by the theatrical managers, not possessing the necessary technical knowledge, troubled themselves infinitely more about the prices they paid than about the good quality of the material they bought. It often also happened that perfectly new apparatus, especially leather hose, would have to be put out of use.

In consequence of these considerations I proposed, and with success, that the Town Council should make the purchases, and have the management and replacement of the movable material and utensils necessary for the safety of the theatres, receiving a share of the evening's takings, included in the tariff of the firemen.

I have consequently succeeded in arranging:

1. That the movable fire extinguishing apparatus should be of one uniform pattern in all the theatres.

2. Full power to test apparatus, and, if need be, promptly replace it, to the great advantage of the continuity of service.

3. Greater freedom in the arrangement of the apparatus, which can be increased according to the nature of the representations, and in case of need even doubled in any theatre,

according to the requirements and the advice of the person who has the responsibility for the service.

* * *

I submit another consideration arising from practical experience in the service of the theatres.

Among the things prescribed by some rules, for towns possessing a water service at high pressure, it is generally stipulated that the internal water supply of theatres shall be derived from the civic supply pipes. But it is not possible to reckon with certainty on any such continuous supply of water, because it has happened, and may happen again, that owing to sudden damage to the principal outside pipes, or to the machinery, the pressure may diminish or even fail all at once, leaving the theatres unprovided.

In order, therefore, that the public safety may be better safeguarded, it is absolutely necessary that the *ordinary* service of extinction should be attached to another *reserve* service, just as the *ordinary* illumination has a supplementary supply arranged near to it, to replace it in case of need.

I do not admit that in large theatres this *reserved* service can be confined to small hand pumps, or to portable fire extinguishers—that is to say, to first-aid appliances. The precautions for safety must be in proportion to the requirements, and for this reason we must admit as reserve only such service as can compare with the ordinary service in point of power.

Alongside of a water supply at high pressure, one might possibly allow, as a reserve, a series of tanks, or an electric pump, by means of which one could play on every part of the theatre.

I am, moreover, one of those who admit the great utility of small apparatus in the theatres—hand pumps and portable fire extinguishers—which serve to extinguish most commencements of fire.

Independent Water Service in Milan Theatre.

At the "Scala" Theatre in Milan, I have made arrangements, in case of a stoppage in the civic water supply, for an electric pump of 1,500 liters, fed from a subterranean tank of about 50 cubic meters capacity. The supply drawn from

the electric pump is so arranged in the theatre as to be able to act from all sides, and that independently of the supply under pressure. The pump is tested every evening, at least twice during each performance, in order to insure its proper working.

Discussion.

Lieutenant-Colonel Fox said—We are much indebted to our friend, the Chief of the Milan Fire Brigade, for having given us the advantage of his experience. His reputation is world-wide. Wherever you go you find that he is known. And therefore this paper does not go forth as the utterance of an amateur; it will go through the civilized world, and will call the attention of governments and corporations to the requirements of theatres, and other places of entertainment. The remarks I made on the previous paper, with regard to the uselessness of fire appliances hanging about the walls without inspection, apply equally to this case of theatres, and more so, because here we have the dreadful risk of loss of life.

Chief-Officer T. G. Dyson said—I should like to say that I have had the honor and the great opportunity of going with Mr. Goldoni to several of his theatres when in Milan, and I could vouch as to his practical knowledge.

Mr. Guy Pym, M. P.—I should like also to congratulate Mr. Goldoni on his very interesting paper. As my friend Colonel Fox says, there is no place where there is a greater likelihood of a fearful panic than a theatre, and we know perfectly well of cases where there has been enormous loss of life in consequence of the panic, and not in consequence of the fire. I think the idea Colonel Fox mentioned just now of some manager of a theatre giving an opportunity every now and then to people who go to his theatre of seeing that the apparatus for their protection is thoroughly in good order is a most excellent one, and I think Colonel Fox would be doing a public service if he went round to all the managers and suggested this to them. With regard to the question of these dummy firemen (because they are nothing else) that engaged our attention very closely on my committee in the

House of Commons, and we had a great deal of evidence on that point. And you will remember in my paper the very strong expression from the committee that: "No license should be granted to any theatre, music hall, or other place of public resort, until the local authorities have satisfied themselves that suitable fire appliances and means of escape for the persons frequenting the same have been provided, and that those in charge of such appliances should be qualified firemen, ready on the spot, engaged in other duties, but able to act promptly in case of need."

RESOLUTION.

The Congress considers:

1. That fire watches in theatres should be manned from the public fire service with the view of furthering the prevention and extinction of fires.

2. That it is desirable to either provide the necessary movable fire appliances of a theatre from the public fire service, or to have such powers as to be able to enforce uniformity of pattern and quality.

3. That theatres require a duplicate water supply service.

The resolution was unanimously carried.

SECTION V.

FIRE INSURANCE, AND ITS INFLUENCE UPON FIRE RISKS.

By Charles E. Noverre, *London Manager Norwich Union Fire Insurance Company.*

Extract.

System of Education.

The system of fire insurance is penalization for risk incurred. The measure of such penalizing is that which experience dictates. It endeavors to teach the public, even in seemingly minor details, where to look for danger, and how to avoid it. Its method of education—and no more effective one could possibly be devised—is to touch its pocket and require that if such and such additional hazard is to be incurred, the insured must be prepared to pay for it.

Defective Construction.

Directly inferior or defective construction is found, such as any part of the external or party walls not being of brick or stone, or concrete, or if any part of the roof be not covered with slates, tiles, uralite, metal, concrete, asphalt, or tercera, or with wired glass set in iron or other hard metal framework, then an extra rate is required. In manufacturing or warehouse risks it penalizes abnormal height, floor openings, such as any spout, trunk, hoist, well hole or staircase through any floor. It mulcts any ceiling of wood, canvas, or other textile fabric, or paper, or any wooden lining to any part of the ceilings or walls. It directs that structural iron work (including columns) should be covered with brick, plaster or cement at least ¾ inch thick, that all rooms and passages, and headings and soffits of all wooden staircases be ceiled with plaster, and that all windows or openings into

areas, courts, or passages between or common to the building and any other building should be protected by outside iron shutters or iron or metal covered door. It takes into careful consideration the cubical contents of a building, fixing as a normal condition those not exceeding 100,000 feet.

Heating.

It stipulates that no building should be artificially heated otherwise than by low pressure hot water apparatus (the furnace or stove for heating the same not having more than three feet of smoke pipe), ordinary fire places, gas stoves, stoves with not more than three feet of smoke pipe, steam heated air, or steam other than superheated steam, i. e., steam entering the system of pipes at a temperature exceeding 350 degrees Fahrenheit.

Lighting.

It disapproves of artificial light other than coal gas, acetylene gas, incandescent electric light or approved electric arc lamps.

Motive Power.

It lays down rules for the installation of electro-motors, and it fines all steam boilers, gas or oil engines unless they be contained in a fireproof compartment within the building, or in any compartment outside the building, not communicating therewith otherwise than by a fireproof door. It also requires that all pipes supplying gas to gas engines should be iron or copper.

Such are the normal conditions laid down to bring manufacturing or warehouse risks within the most favorable aspect for rating.

The tariff offices have prepared specifications for builders to follow in erecting fire-resisting buildings, and if they be strictly pursued large discounts or reductions in rate are allowed. These, of course, specially apply to certain tariff-rated risks, but it may be taken for granted that where these are observed in those risks not governed by tariff, minimum rates for the class of risk are alone charged.

Rules for Standard Fire-Resisting Buildings.

NOT INCLUDING

COTTON MILLS, FLAX MILLS, WOOLEN MILLS AND WORSTED MILLS.

Height and Area.

1. Height not to exceed four stories and cellar. The ceiling of the cellar not to be more than 3 feet above the lowest point of the land level or ground line of the site on which the building stands.

2. Superficial area of any one compartment not to exceed 25,000 square feet internal measurement, excluding area of window recesses and doorways.

N. B.—The height of any compartment, excluding cellar, to be not less than 12 feet, measuring from the floor level to the highest point of the ceiling.

External, Party and Internal Walls, and Partitions.

3. Brick, terra cotta, or cement concrete composed of broken brick, burnt ballast, furnace slag, clinker, or other similar hard and burnt material.

4. No external or party or division wall to be less than 13 inches thick in any part, or if of concrete 20 inches.

N. B.—Stone used externally only as ashlaring or facing, with a backing of brickwork not less than 13 inches thick, and for dressings, sills, string courses and cornices, allowed.

5. All internal partitions to be of incombustible material, excepting only office enclosures of hard non-resinous wood with or without glazing.

6. If there is any building adjoining the dividing or party wall to extend at least 3 feet above the roof of the fire-resisting building.

Flues.

7. All flues to be built of brickwork, no part of which towards the interior of the building is to be less than 9 inches thick, and all furnace flues to be lined with fire-brick through-

out for a distance of at least 20 feet from the furnace. No timber or woodwork to rest in or be plugged into the brickwork of any flue.

Openings in External Walls.

8. The total area of openings in the external wall of any story not to exceed one-half of the area of the wall (measured as to height from floor to ceiling of the story in which the openings occur). All loophole or teagle doors and frames and window frames and sashes to be of iron or other hard metal.

9. Every window or other opening opposing (whether directly or diagonally) and within 20 feet of any window, skylight, or glazed or other opening in any other building (whether such latter window, skylight, or opening be protected or not), or overlooking (whether directly or diagonally) and within 20 feet of the non-fireproof roof of any building to be protected by "fireproof" shutters or "fireproof" doors which are automatically self-closing in case of fire.

Floors.

10. Brick arches, terra cotta, fire-clay, or concrete as above described, the floor being in no part less than 6 inches in thickness, and carried on metal joists, girders and columns, or brick walls or piers.

Solid Wooden Floors Allowed.

N. B.—Floors of wood not less than 9 inches thick, ceiled with plaster on metal lathing, and with the floor boards laid on the bearers without intervening space allowed.

11. Wooden flooring laid on brick arches, terra cotta, fire-clay, or concrete as above described allowed, provided there is no intervening space. Wooden fillets not exceeding 3 inches deep permitted if laid on brick arches, terra cotta, fire-clay, or concrete as above described, the intervening spaces being filled with incombustible material.

12. Scuppers to carry off water, the opening of each of which shall not be less in area than 21 superficial inches, to be provided in the external walls to each floor at intervals of not more than 25 feet.

Roofs.

13. Roofs to be entirely of the incombustible materials as described for floors in Rule 10 except that 4 inches be substituted for 6 inches in thickness, but there may be erected above them light shelters or roofs constructed entirely of incombustible materials.

Wire Glass in Skylights.

Note—Glass not less than $\frac{1}{4}$ inch thick in sections not exceeding 36 superficial inches, and wired glass not exceeding 1-inch mesh, in sections not exceeding 144 superficial inches, in either case set in metal, shall for the purpose of this rule be deemed incombustible.

Outlets on to roofs rendered necessary to satisfy the requirements of the Factories and Workshops Acts permitted, provided that all doors and frames be of iron or cased in iron-plate at least $\frac{1}{8}$ of an inch thick, and that they be self-closing.

Protection of Structural Metal Work.

14. All columns or stanchions to be covered with brickwork or porous terra cotta (at least 2 inches thick), or with cement, concrete, or plaster at least $1\frac{1}{2}$ inches thick, keyed into metal supports and protected by a metal guard up to a height of not less than 4 feet from the floor where cement, concrete or plaster only used.

15. Girders, joists, lintels, and all structural metal work (other than columns and stanchions, but including framework of roofs), where not covered with brickwork, to be completely incased in porous terra cotta at least 2 inches thick, securely anchored, or cement, concrete or plaster at least 1 inch thick keyed into metal supports.

16. Space must be left at the ends of girders and joists to permit of expansion.

Linings and Ceilings.

17. No lining of wood or textile fabric, to any part of the walls. partitions, ceilings or roof.

Floor Openings.

18. No openings through any floors allowed except holes to admit steam, gas and water pipes, and iron or earthenware tubes for electric conductors. All pipes and tubes to be cemented round the full thickness of the floor.

N. B.—All staircases, hoists, rope and strap races, and gearing towers to be external to the four walls of the building and constructed entirely of brick or cement concrete, as above described, at least 9 inches thick.

Hoists must be constructed in the staircase inclosures, and no opening thereto to be less than 6 feet from any opening into the building. Excepting hoists, the inclosing walls must be carried through and 18 inches above the roof of the building, and the roofs, stairs and landings of said inclosures must be constructed of incombustible material. No openings permitted between the building and the rope and strap races and gearing towers, and each opening from the staircase into the building to be protected by a "fireproof" door.

Shafting Through Walls.

19. Shafting, where passing through walls, to fit closely into wall, or have wall boxes closed with iron plates, not less than ¼ inch thick, leaving no open space.

Pipes and Electric Conductors.

20. All pipes in the building, except water pipes not exceeding 1½ inches in diameter, to be of hard metal. No wooden casing to be used for inclosing electric conductors.

Communicating Compartments.

21. Two or more compartments, each constructed in accordance with these rules, may communicate, whether by double "fireproof" doors or otherwise, provided that their aggregate superficial area does not exceed 25,000 square feet.

22. Two or more such compartments, whose aggregate

superficial area exceeds 25,000 square feet, can only be allowed to communicate across a fireproof compartment built up from the basement with walls of solid brickwork, and constructed in all other respects in accordance with these rules so far as the same are applicable, and having all openings protected by " fireproof " doors at least 6 feet apart.

23. Except as above, no communication allowed between a compartment constructed in accordance with these rules and any other compartment.

FIRE OFFICES' COMMITTEE,
63 WATLING STREET, E. C.

SECTION V.

FIRE HAZARDS IN AMERICA FROM AN INSURANCE POINT OF VIEW.

By W. H. Stratton (since deceased), *Executive Chairman, National Fire Protection Association, U. S. A.*

Extract.

Cost of Factories.

The brick and timber of a standard mill constructed in some parts of the United States because of natural conditions, may be obtained for at least half the cost of the same material in another part of the country. This, of course, will make a wide range in the cost per square foot of floor surface of the same type of structure in different parts of the same country, but for an average, it is fair to assume that with the present prices of labor and material in the United States, a four-story standard cotton mill may be built and equipped with power, plant and fire protection at approximately $1 per square foot floor surface. This figure has no reference to the equipment of machinery.

Cost of Mill Construction per square foot Floor Space.

Comparison with English Methods.

From what I can learn, the materials used in the cotton mills in England are mostly metal girders and brick arches, and the cost of building mills of this character in years past due to local conditions has been 20 per cent. to 25 per cent. less per square foot than the brick and timber standard United States mill would have cost. Possibly at this time the cost is nearly equalized, but the availability of material makes the preference in England for the established type of structure. This naturally accounts for what may be described as the standard textile mill of England and its cost compared with the standard textile mill of the United States and its cost.

Relative Merits of Different Types of Construction.

Having already stated the natural conditions affecting the choice of method of construction, I will next refer to the relative merits of these two types of structures for cotton mills, which class, by the way, has been chosen as that representing conditions which involve the handling of one of the most hazardous materials known to the arts, and which has been recognized as needful of more protection from a fire insurance standpoint, or supposedly so, than other materials less susceptible to the rapid attack of fire.

Slow Burning Construction.

It is quite natural to suppose that brick and iron will resist the attack of fire more effectively and for a longer time than a building of four brick walls with the floor and supports of wood, but such is not the case. A mill built in accordance with the standards commonly practiced in the United States in cotton mill construction, which is briefly described as having brick wall, heavy wooden posts and bearing beams with heavy plank floors, all woodwork solid and having no openings, will withstand attacks of fire longer than the very best type of metal beam and brick arched construction for the reason that the same amount of heat applied to this heavy timber construction, which would in a reasonable time make inroads upon the wood to the extent of burning one-half inch deep, would heat up the metal members, which, by the way, when heated are not strong enough to hold themselves up, and wreck the building. The same fire also might be continued until the heavy wooden floors and timbers were burned even to a greater depth without affcting the structure as a whole, and immediately that fire streams are applied to the surface of such timbers, they will check the fire and put it out, whereas a structure depending upon metal members under the same conditions, attacked by fire streams, would so distort and affect the metal members as to aid in the work of tearing down the building owing to the effect of the cold water thrown on the hot metal. In support of this position a slight demonstration of fire upon heavy mill timbers and steel beam supports which occurred in an actual fire is herewith illustrated by photograph.

On the other hand, a structure of metal beams and brick

arches, if properly protected with automatic sprinklers, might be expected to make the above comparison inapplicable; nevertheless, there would always remain the possibility of water being temporarily shut off of the sprinklers, in which event the superiority of the United States standard would at once assert itself, and is therefore chosen by us to be maintained as long as commercial conditions favor its adoption. At any rate, the time would seem to be too far distant for immediate consideration of the giving out of the natural products upon which we now rely for these structures.

So much for the reasons of adoption and the effect of construction which we call standard in the United States.

Heavy Fire Losses a Natural Result.

At this time it would not seem out of place to refer briefly to statements concerning the heavy fire losses in the United States. Consider if you will the rapid growth of the United States in the past one hundred years, during which time there has been a continuous development and establishment of new towns and cities which have grown up in a night, as it were. Even at the present day new settlements are being made within the confines of our country, all of which tends to favor the introduction of undesirable conditions and to make a large fire waste but a natural result owing to the rapid growth of our cities with flimsy and undesirable buildings.

This subject is one of world-wide importance, and demands the enactment and enforcement of laws which will remove from all future structures the worst elements existing in such properties, those which contribute to the spread of fire, cut off the escape, and involve the whole property so quickly that no equipment that can reasonably be provided or handled will protect the exposed lives and property. All buildings should be built solid, or at least without flues to carry fire. Features of ornamentation should be sacrificed if necessary to bring about practical and humane conditions; but after all this has been done to retard the progress of fire it still remains advisable to introduce some measure of fire protection as a further safeguard against disaster.

This great question, which involves immense money values, but above all the safety of many, many lives, is, after all, a simple mechanical problem within the scope of every country, and can be solved by the introduction of improved methods of construction and the application of automatic means for extinguishing fires.

The Automatic Sprinkler.

This brings us to consideration of that one device which has done more than all else to bring the fire loss within our control, namely, the automatic sprinkler.

Cost of Sprinkler Fires.

The actual records of fires to date in all properties covered by automatic sprinklers shows an enormous possible saving, and even these figures include conditions which affect the result adversely because a large number of fires that have cost excessive amounts in sprinkler-protected properties have gone beyond what the average would otherwise have been, because of the lack of water supplies or attention on the part of the owners of the property.

As was natural to expect, automatic sprinklers were first used in extra-hazardous classes, such as cotton mills, rubber works, woodworkers, properties where the rates were high and the hazard was well known by insurers and acknowledged by the assured, and even under these conditions, which are the worst that could be met with, we have the result that the average cost per fire in sprinkled properties is something about $250, while the average cost per fire in unprotected special hazards, no doubt involving many of the lighter and better classes of risks, is commonly accepted to be about $7,500.

The Sprinkler Protects the Business.

This is the direct result of the application of the automatic sprinkler, and would ordinarily be considered in itself as sufficient argument in favor of the introduction of this device; but the advantage is even more far reaching, for the property-owner and manufacturer finds that this device prevents his

business from interruption by fire, and thus protects those values against the loss of which it is impossible for him to secure insurance indemnity.

The Sprinkler Has Never Failed.

In further reference to this particular question of protection, I desire especially to make record here in a public expression that the printed statements that have appeared from time to time referring to failure of automatic sprinklers cause a wrong impression and are unjustly made. There never yet has been a failure of automatic sprinklers where they have been installed and maintained in keeping with the principles of the device. The principles of the automatic sprinkler are that it must be installed to cover all portions of a property, that it must be supplied with water under sufficient volume and head, that it is only designed to check a fire in its incipiency, and should not be expected to put out conflagrations or fires in materials that water will not extinguish, such, for instance, as burning oils and varnishes.

Confined strictly to the ordinary conditions of manufacturing or mercantile properties, properly installed and maintained, it has never failed, but has always more than met the expectations of its advocates and supporters.

Primary Water Supply for Sprinklers.

Reference has been made to the wide range of contingent features connected with the subject of fire protection, and perhaps the first question for consideration after you have a good building constructed is the water supply. The existing water supplies must be first examined, and while the application of a pressure gauge to the water main is the usual procedure, still this is only one of the many questions that must be investigated to decide upon the desirability or effectiveness of a water supply. The size of mains, the distance of travel, and the permanency of a supply must all be considered, and if any of them is questionable, then the public water supply had best be depended upon only as an auxiliary of a questionable character, and a private equipment for the property then becomes a necessity.

Private Tank Supply.

For private supply, no matter how large or how small the property, the general conditions are the same. First we must have a supply of water of moderate volume, at a good pressure, maintained exclusively for the automatic sprinkler. No way possible to draw this water should be left open, either for private or public service or through hydrants of the equipment.

The tank supply, which is usually the simplest and least expensive of the primary service, which is created to take the place of natural conditions, is sometimes misunderstood.

Fallacy of Large Tanks.

For instance, there is a growing custom in some sections and by some authorities on the subject to put large tanks of 30,000, 40,000, 50,000 and even 100,000 gallons capacity upon trestles high in the air. The inconsistency of this proposition is readily explained as follows: If automatic sprinklers are properly installed and the water is kept constantly in service, the record of sprinklers since their creation up to the present time shows that more than 80 per cent. of the fires are controlled with less than ten sprinklers. Ten sprinklers represent approximately 250 gallons of water per minute. A fire that is going to be stopped by automatic sprinklers or checked by them will, within the records and history of the sprinklers, be extinguished inside of ten minutes. Now, with ten sprinklers open, playing 250 gallons per minute for ten minutes, we have 2,500 gallons, but to make sure of the proper results owing to certain contingencies, we will introduce a factor of safety of say 5, which will make 12,500 gallons, an amount that will take care of extreme and abnormal conditions.

For instance, ten heads might suddenly be liberated by a fire of great intensity in a material which would make excessive smoke, and therefore the question as to whether the fire was out and it was proper to turn off sprinklers or not might delay that action and cause the sprinklers to run a long time unnecessarily, or on the other hand, they might possibly be shut off too quickly and the fire break out again.

As we do not, however, depend entirely upon the automatic sprinkler, but expect it only to hold the fire in its incipiency, the writer makes no hesitancy in stating that, no matter how large the equipment, 15,000 to 20,000 gallons is sufficient for primary supply provided it will give good head or pressure for the sprinklers.

Tank capacities need not be considered as relative to the floor area of a building. When sprinklers do their duty they will do it in any portion of a room 500 by 100 feet within the same area as in a small room, and these arguments are presented as reasons for opposing this questionable engineering proposition, not to mention the extra expense upon the assured, involved in putting up excessively large tanks on separate foundations when a 15,000-gallon tank will do just as well.

Many accidents have occurred from putting large tanks upon buildings, and the least weight we can use with safety is desirable for that reason also; but above all things no tank capacity may be expected to meet with adoption generally which will exclude the necessity of a fire pump. It is a temporary immediate supply of water until the pump or other secondary source can be brought into use.

Secondary Supply.

Having at the expense of considerable time and space established the status of the automatic sprinkler and the primary supply of water as the most reliable safeguard, and the one having, in a short period of existence, shown a superiority over all other methods as a life and property saving equipment, we are still confronted with the possibility of needs for a more powerful and extensive service not limited in capacity, should by any chance a fire take place when any part of the sprinkler equipment was disqualified or should it involve a large quantity of inflammable material, such, for instance, as in cotton storehouses. Then, of course, we must provide for a reliable and if possible an inexhaustible supply, to be applied by pumps to hydrants and possibly sprinklers, and hence our choice would naturally first fall upon a pond or river as a source which might

reasonably be determined upon as having the necessary qualifications.

Such supply not being available, artificial means must be resorted to, as, for instance, a large reservoir that may be kept in reserve for such emergencies.

Going back to the first choice, the river or pond continually supplied, much care should be observed in the selection of a point and the conditions under which the suction shall take water, particularly to prevent the drawing of mud or sediment through the pump. Reservoirs should also be constructed with a low point, out of which the pump should take suction, the pocket being below the level of the bottom of the reservoir, so that every gallon of water will be available. Elevated reservoirs are very desirable, but often involve great expense and questionable engineering conditions.

All of these points are within the duties of the engineer who chooses the mill site and plans for its construction and equipment, but all insurance authorities should be familiar with the necessities in order to present their importance to the owners and to discuss them with the architect or engineer. It is difficult, however, to properly adjust this question with such engineers or contractors as have no permanent interest in the property, and even the owners themselves are sometimes slow to realize the necessity for the large amount of water called for.

Should Be Inexhaustible.

One case which will illustrate the needs very forcibly involved a matter of about 1,000 bales of cotton in a storehouse. Fire was discovered in the cotton and it was necessary to remove it all from the building, separating it in the mill yard, to prevent that which had been on fire from exposing that which was supposed to be absolutely unharmed, and in order to extinguish the fire it was necessary to keep streams of water playing on it three days and nights. It was calculated that something like 4,000,000 gallons of water were drawn from the river and used in this event. Now, if the ordinary estimate of the quantity needed for reservation for fire purposes, such as is usually advised by those inexperienced in these needs, had

been provided in a reservoir of limited capacity, it is easy to see that there would not have been enough water to put out the cotton which was on fire, in addition to which the mill itself and all other property would have been left without protection when the water was gone.

Another instance is recalled, a matter of 2,200 bales of cotton in a three-story warehouse, on which water was thrown for six days and nights. This water was also drawn from a river, and from the number of streams and the capacity of pump there is no doubt that 10,000,000 gallons of water were used, and even after the fire was supposed to be extinguished and the cotton was sold the fire again broke out.

These cases are cited only to show that a large amount of water is often required to outlast a fire, and while they are rare instances, such conditions should be guarded against in every case where they are possible to arise, for that is the basis of factory protection.

There are other classes of manufacture where it can be readily conceded that these extreme conditions might not be expected; but the judgment of the insurance enginer should be carefully applied to all contingencies and possibilities, for it must be remembered, in prescribing the conditions of protection, that a building erected for one kind of manufacture involving a certain class of stock may be called upon for other use if the original venture does not prove satisfactory. For instance, a building constructed for the working of metals might at some time be altered and used for the manufacture of cotton, and thus the choice of location and the selection of water supplies is a very, very important feature of the first consideration in the preparations for a manufacturing plant.

Fire Pump.

We now come to the fire pump. This subject alone is one of sufficient importance to form the basis of lengthy consideration, more so than we shall give to this whole question.

The construction of a fire pump needs peculiar treatment, and its single purpose should be to make an effective and powerful delivery of water without reference to economy of

operation. The parts should be simple, interchangeable, and made as strong as every estimated need shall call for, and an extraordinary factor of safety added, for the conditions demand such precaution. The whole question is covered under a separate treatise on pumps which will shortly be published and available in pamphlet form.

The pump makers and the insurance companies will soon have this matter so adjusted that in any country satisfactory pumping engines will be available.

Location of Fire Pump.

Here, however, we cannot stop, but must add that when we have picked out the water supply and the best pump to protect the property, then we must in turn protect the pump. To do this it should be first placed in a separate pump house, close to the boilers, while the boiler plant and the pump station should both be safeguarded so that they cannot be rendered inaccessible or inoperative on account of fire in any other buildings of the property; added to which the steam piping should all be carefully arranged so that the breaking of a steam pipe of the power plant or within the mills would not cripple the boilers and leave the pump inoperative.

Proper Connections for Pump.

Illustration of how the pump should be piped is submitted herewith, and one small feature is pointed out to show the importance of these apparently minor details. I refer to the steam connection to the yoke of the steam chest as shown in the cut. The steam pipe drops directly down and straight past the entrance to the yoke and the throttle of the pump is placed in the horizontal pipe so that all condensation, chips and all foreign matter in the steam pipe will fall directly to the bottom of the steam connection below the pump and entirely clear of it, by means of which all condensation will be carried off through the steam trap and all obstructions that would otherwise go into the steam valves will collect and can be removed from the trap.

To emphasize the importance of this attachment, we can refer to two cases where such connections were omitted from the pump and where the condensation was instantly turned into the pump, causing the wrecking of the pump, in one instance killing one man and injuring another.

Cast-iron Water-mains.

The pump having been installed in operative condition with all safeguards, we next come to cast-iron water-mains for underground service. Standard specifications have been prepared and certificates of test submitted, but all these precautions are not an absolute safeguard, and our inspections require in addition that when the pipe is laid and before the ditches are filled the whole system shall be submitted to 150 pounds water pressure for at least two hours, during which time large valves and hydrants will be opened and closed rapidly, to approximate conditions of water hammer that would follow through hurried use in time of fire.

Test of Water Mains.

The standard for cast-iron water-mains is now in print, but does not protect the underwriter or the mill owner, for the reason that while the pipe may be made in accordance with the standard, it may be cracked in shipment or installation, and we therefore commend the one short rule, " test the pipe after it is laid to 150 pounds for two hours," as the only proper safeguard.

Hydrants.

Next comes the question of fire hydrants. After the extent of the property and the service anticipated has been adjusted the hydrant mains should be of sufficient capacity to support as many fire streams as the combined water supply will maintain, but no pipe less than 6 inches should be laid underground. Hydrants should be placed about 50 feet from buildings to be a safe distance and should be located 150 to 200 feet apart around the property. They should have at least a 6¼-inch inlet valve for three 2½-inch fire streams, which type should be used universally.

Plenty of Hydrants Best and Cheapest.

It will be observed that by placing the hydrants 50 feet from the building and not over 200 feet apart, the full water capacity may be concentrated in the locality of the fire with the use of short lengths of fire hose, which it is proper to state is a measure of economy brought about by a little increased expenditure in the original equipment. A few additional hydrants make available, with a small supply of hose, all the fire-fighting facilities of the water supply, and it is well known that a liberal equipment of hydrants and a small supply of hose results in an annual saving, because the hose is the most perishable part of the equipment and must be replaced from time to time to be maintained in effective condition; thus the smaller the equipment of hose required the less amount of hose it is necessary to purchase from year to year.

Another feature of importance is that all wrench heads for valves and hydrants should be of uniform size and shape, so that one wrench will fit the entire equipment, 1¼-inch square head being the size universally adopted in the United States.

Fire Hose.

As stated above, this important part of the equipment for fire protection representing the perishable portion should be carefully selected and properly cared for. In the United States we have adopted, under specifications which are issued by the National Board, 2½-inch woven cotton rubber-lined hose as being the most durable and yielding the best results, both as to frictional loss and strength for the lightest weight. Such hose has been known to last with careful handling from five to ten years, and is sold in the market at a few cents in advance over the cost of the old competitive class of goods, with which there is no guarantee, and which sometimes rapidly deteriorates and needs replacing inside of a year.

Hose Houses.

To make the hydrant service immediately available in the simplest form a standard has been adopted for hose houses, to

be built over the hydrants and equipped with a specified outfit, which is a very valuable time-saving feature in the event of fire. Printed standard for this is also in circulation.

Private Fire Department.

In order that the expensive equipment of pumps, mains, hydrants and hose may be understood and used for its full value in time of fire a standard for the organization and drill of private mill fire departments has been prepared, printed for circulation, and universally adopted throughout the United States.

Fire Doors.

As a part of the fire-resisting apparatus of a mill where necessary openings are made in fire walls, a universal standard has been adopted for what is known in the United States as "tin-clad doors," otherwise called "armored doors." These doors are made of three layers of dry light wood, the combined thickness being approximately 2½ inches, nailed together diagonally to adjust the warp and twist, all of which is fully covered in the printed pamphlet on the subject. The virtue of this door depends upon a strict adherence to the standard; if the hangers are too light the door will be of proportionate value, but when a fire reaches a magnitude to call for such a stop, and as the fire door is expected to be as effective as a brick fire wall at least 16 inches thick, it will be found that the standard is none too severe to be secure.

Fire Pails.

It is the custom in the United States, and no doubt the world over, to provide casks and pails for immediate use in incipient outbreaks of fire. It is not too much to say, because history indicates it, that this simple measure of protection, when promptly used, has extinguished more fires without any loss than any other means of protection. Therefore, fire pails and casks should be liberally provided in all properties and the help instructed of their value and use, particularly to avoid a waste of the small amount of water available. The fire pails

are considered simple and effective and much more readily understood than patented devices, which oftentimes deteriorate before they are needed.

Co-operation by the Assured.

It becomes the duty of the owner, in his own interest and as a business obligation, to make regular and complete inspections and records of the structures, their contents, their equipments and the maintenance of the fire protection generally.

Inspection by the Assured.

It is now the custom in the United States for large manufacturing plants to maintain one or more reliable men of their own employ for frequent inspection of the apparatus, using a simple form or blank upon which their reports may be made, so that they cannot overlook the supervision of any of the items. These special men are instructed to see that those valves which should be closed are closed and that those which should be open are open; that water pails are kept full; that rubbish, sweepings and other dangerous elements for spontaneous combustion are regularly and thoroughly removed from the premises; that fire doors are not obstructed; that such doors as are required to be closed are closed at a stated time; that the entire force of help becomes familiar with the measures of safety provided for the preservation of the property and for the lives of the employees, so as to prevent a panic; and last, but not least, that any feature of the fire apparatus which becomes temporarily disabled shall be immediately reported to an established authority, so that they may be promptly corrected.

Inspection.

Thus far we have considered the preparation and the maintenance of the fire equipment, both as an original measure and for its careful supervision by the assured, but after that the insurance interests must have a basis upon which they may intelligently and regularly inspect the property and the appliances.

For example, before we insure a property it is inspected by a man who is competent as a mechanical, hydraulic, electrical, and usually, above all, a most thoroughly experienced insurance engineer. Under these various heads and acting in co-operation with the mill engineers and architects, and manufacturers and erectors of the devices for fire protection, we bring about, before the insurance is accepted, so far as the present state or knowledge of the art permits, the highest class of conditions.

Inspect the Property Quarterly.

Then, after the equipment is once installed under these conditions, we inspect it every three months.

These inspections should develop the introduction of new or hazardous material or process and should review all the private inspections of the fire appliances, which should not be permitted to commute for a full and perfect examination of everything by the inspector, in accordance with the furnished blanks.

Discussion.

Mr. J. P. Gray said—The experience of the Mutual Companies in the cotton mills of which he speaks, I think, has been very broad. In those mills it is not an infrequent thing to have not 10 sprinklers open, but, perhaps, 100, which may call for 1,500 gallons of water or more per minute. That being the case, they have recognized the fact that tanks of 5,000 to 10,000 gallons capacity are not sufficient to supply those sprinklers until we can get a large fire pump in operation, which in nearly every instance will take any time from 10 to 20 minutes. We have had notable examples of that sort, and, therefore, we have taken up that question of larger tanks, until to-day a 25,000 gallon tank is the smallest tank we put in, and they run from that size to 100,000 gallons. We believe it is safer to err on the side of safety rather than to take any chances whatever. That is one great reason, but Mr. Stratton may have some special reason which is not stated here, which I should have liked to ask him, and possibly you can answer it, sir.

Size of Tanks in New England Cotton Mills.

The CHAIRMAN—I am afraid not, Mr. Gray. I am aware that Capt. Stratton's views tend toward smaller tanks, because he has frequently expressed himself in that way, but, further than the arguments that are given in the paper itself on the question of ten sprinklers and 80 per cent. of the fires, there is no reason that I know of.

Mr. E. S. REYNOLDS—There are two questions that I should like to ask. I notice in this paper all fire protection rather confines itself to the questions of loss and water, and may I ask how far chemical extinguishers or other means are in use, and if they are found to be satisfactory? Are they generally recommended for use? My second question is, if the automatic sprinklers are so much used in retail establishments, and so on, whether they are recommended for those smaller risks? I am speaking of smaller stores rather than the huge ones which I know you have in America.

The CHAIRMAN—With regard to the first question, as to chemical extinguishers, I would say that in very recent years, since we have been able to take up the standardization of chemical extinguishers and examine their construction, and listing only such as have passed a very critical examination in the laboratories, the chemical extinguishers are becoming more and more used, particularly so in the ordinary risks, not in the manufacturing risks, but in large stores and dwelling houses even. Those extinguishers with us up to the present date are not officially recognized by underwriters; there is no special allowance or rate for extinguishers, but in quite a number of places an extinguisher of three gallons capacity (an ordinary extinguisher) is accepted in lieu of six fire buckets. That is, where there were six buckets for an area of about 2,500 square feet we would accept one extinguisher. And in fine hotels and office buildings the fire extinguisher is much more sightly than rows of buckets. It is very frequently used. As to the number of sprinklers, the question of sprinklers is being largely put forward in the protection of property of all kinds—other than manufacturers' risks—in warehouses, and larger and smaller stores, and theatres, and quite a large num-

Chemical Fire Extinguishers.

ber of properties where the basement or hazardous portion allow it, protection is being put in under the form of sprinklers. We have in Philadelphia, I think, about 450 fully protected sprinkler risks, and that for a city of the size of Philadelphia is quite a large number.

Mr. JAMES SHEPPARD—May I ask a question? I have not noticed that any reference has been made to sprinklers in grain elevators, in which, I fear, they have not been so successful as in other risks. And there may be certain risks where some special arrangement may be necessary to get an effective sprinkler installation. Any information on that point would be of interest.

Sprinklers in Grain Elevators.

The CHAIRMAN—While quite a large number of elevators in the western parts of the States are protected by automatic sprinklers, so far as the matter of the prevention of fires is concerned, the sprinkler has not been a very great success in the case of elevators. There have been some notable exceptions, of course. It must be remembered that with us, particularly in the West and Northwest, the sprinkler in the elevator must be a dry pipe system. The construction of our elevators, which I do not suppose foreign gentlemen are familiar with, is such that in the highest portion there are large, roomy spaces which must be protected, spaces which are frequently covered with dust in every available part of the structure; every joist, every column is covered with a fine, impalpable and inflammable dust. The question of the sprinkler is a very serious question should it be successful. Then, again, as I say, the systems are all dry piped; they are frequently protected tanks; and, as the elevator is usually, in our area, fully 200 feet up, the protection of a large tank at that elevated point is a difficult feature. As a rule, the protection of elevators by sprinklers has not been a very great success; that has been proved by the reconstruction of the Weston elevator. Now instead of having a large wooden building covered on the outside with slate or metal, we have a wooden building covered with incombustible material, and with the elevating apparatus in a separate building, so that fire from a rapidly revolving machine will not endanger the

large value of the grain—some of our elevators holding 250,000 bushels of grain at a value of 75 cents per bushel.

Mr. WORMALD—I think this paper will be very valuable in this country, as it shows the difference between the practice in the United States and the practice at home.

Mr. W. BENNETT GOUGH—It is not becoming in me to make any reference to that portion of the paper that deals with sprinklers. With regard to the type of construction of mills, it might interest members here if I mention that my firm have just completed the erection of a factory building in Manchester, built to the American specification—what is known in your country, I believe, as the slow burning construction, and which is fully detailed by Capt. Stratton. We were not able to put up that factory without a considerable amount of difficulty, but we went into the business with our eyes wide open, and, of course, after having made a comparison of the cost; and that comparison bears out exactly what Capt. Stratton says here, although he did not know anything of the building I am speaking of, and had never seen it. It would be very much more expensive in this country to put up a slow burning construction than to put up what we call a fireproof construction, entirely of brick and concrete. We have built this factory building with square timber posts and timber beams, and heavy plank floors, with an American hard maple floor board, the total thickness being about five inches of solid flooring altogether—no joists, no spacings, and with sprinklers down the centre of each bay. We think we have got a building that cannot possibly burn. On the other hand, I think it would have been more convenient, and certainly it would have been cheaper, to have had the fire-resisting building of the standard English construction. A word with regard to what Capt. Stratton has called the hazard of large tanks. As I drew up the Automatic Sprinkler Rules of 1884 that have been adopted in this country, I may say that I commenced with a figure that Mr. Gray will possibly be astonished at—it is 3,000 gallons of water for small risks and 5,000 for large. The standard now is 5,000 gallons as a minimum and 7,500 as a maximum. That

Size of Tanks in England.

is (as Mr. Sheppard will confirm, I think) the practice of the offices here. In extra risks, where we think there is what we call a compound hazard, the offices call for a 10,000-gallon tank occasionally, but we have not found any risk in adopting those standard capacities. I do not know that we have any experience in the United Kingdom or on the Continent of Europe where the quantity of water in those tanks has proved insufficient to cope with the fire. I only remember two cases where over 100 sprinklers have been opened on a fire, and in those cases the pumps were got to work, so that there was plenty of water. I may say that where the pump is a secondary supply in most cases we have the pump automatic, so that the tank is never called upon at all. The last point I wish to refer to is one which is of intense interest to me, and that is the question of cast-iron mains in relation to hydrant service outside. I think the question is one which cannot be thrashed out too thoroughly, and we cannot drive home. in this country, sufficiently. I refer to the want of standardization in the sizes of fire hydrants in the United Kingdom. I do not know—Mr. Sheppard will perhaps inform me—whether there is any schedule size of pipes (I don't believe there is) established by the Fire Offices Committee in this country.

Mr. SHEPPARD—I am afraid there is not.

Mr. W. BENNETT GOUGH—I thought not; and what is the result? We have buildings put up with mains in the yard of 4 inches and risers of 3 inches inside the building. I remember reading in an American paper a remark—I forget who was the writer—that a man who put a hydrant of less than 6 inches in his establishment ought to be hanged.

Mr. GRISWOLD—That is by Mr. Tebb, one of our hydraulic engineers, who has laid down large numbers of works in New England.

Mr. W. BENNETT GOUGH—Well, I think Mr. Tebb is to be congratulated on his courage, because there is no doubt that the 3-inch and 4-inch standard is totally inefficient. I confess myself to be a sinner in that respect, for only the other day I laid out a hydrant service calling for about 10,000

gallons. I started with 7-inch and got down to 6-inch, but where I had to take branches from the main hydrant I reduced to 4-inch. I never put more than two hydrants on a 4-inch pipe, but here you have established 6 inches as the minimum size of the pipe. I think this is a subject that might very well be ventilated on this occasion, and it is one to which attention should be drawn. I think if fire officers here would give engineers some lead in the matter there would be a chance of improving the standard of hydrant protection. I would like, Mr. Chairman, to ask a question of you personally. You mentioned that in Philadelphia you had 450 risks protected with sprinklers. How many of those would be non-manufacturing risks and how many manufacturing risks?

The CHAIRMAN—It is a difficult question to answer. I should think two-thirds, at least, would be manufacturing risks of different kinds.

SECTION V.

THE IMPORTANCE OF OFFICIAL INVESTIGATION AND OF STATISTICAL RESEARCH INTO THE CAUSES AND EXTENT OF FIRES.

By James Sheppard, *The North British and Mercantile Insurance Company.*

Extract.

It is important to remember that all waste by fire falls upon the community at large. Fire insurance simply distributes part of this waste over the whole body of premium payers; the subject is, therefore, one that directly concerns the public.

The science of fire prevention shows how the waste referred to may be as far as possible avoided, and fire retained within limits of usefulness to mankind for the benefit of present and succeeding generations, and embraces three main divisions, as follows:

1. Provisions to guard against the occurrence of fire.
2. Provisions to prevent the spread of fire through buildings and their contents, or to surrounding buildings.
3. Provisions for the early discovery and alarm of outbreaks of fire and for their prompt extinction, and for the saving of life.

The subject of the present paper falls under the first of the above divisions, and incidentally also under the second.

To effectually guard against the occurrence of fire it is necessary to have as full a knowledge as possible of the causes from which fires originate, and such information needs to be tabulated for different periods, districts and trades, so that reliable comparisons can be made, with the view of applying remedies which these returns may show to be necessary, and

so prevent the recurrence of fires, and place due restraint on negligent, dishonest, or malicious fire raising.

The Parliamentary Select Committee on Fire Brigades, 1900, state in their report: "That as a general rule no official records as regards fires are kept or are available," and express the opinion "that full and accurate information on the subject would be of great public interest by showing the extent and particulars of the losses both in life and property which are caused by fire, and the Committee recommend that local authorities should be required to furnish to a Government department full particulars of all fires as they occur, and that annual reports should be published containing the information so obtained."

This agrees with recommendations made by many previous Parliamentary Committees.

Corresponding information with reference to other branches of social economy is already collected, both in the United Kingdom and other countries, the Governments of which prepare and publish full particulars with reference to—

Population, births, marriages, deaths;

Health, disease, insanity, accidents, crime, etc.

Fires are responsible for the loss of many lives, the destruction of millions of property, including art treasures that cannot be replaced, are frequently of criminal origin, and often deprive, for long periods, large numbers of industrious citizens of the opportunity of earning a livelihood for themselves and families.

Information as to the causes of fires is therefore quite as important for educational and correctional purposes as that now available with regard to the subjects referred to above. With the exception of Russia and some of the States of North America (United States), national returns of fires with their causes are not available.

In the principal cities of some countries police investigations are made with regard to fires, and the payment of any insurance money is required to be deferred until after the conclusion of such inquiry. This, it is understood, explains the large

number of small fires included in the Berlin police returns to which the fire brigade were not called.

In most countries existing machinery could be utilized for organizing a system for investigating into fires as suggested without material addition to present public expenditure. Part if not the whole cost of such investigations should in a majority of cases be charged to the person occupying the premises on which the fire occurred. This course is already adopted in the case of steam boiler explosions, and persons on whose premises a chimney takes fire are now liable to be fined. The extension of this principle to all fires would be of great public advantage, and be in every way equitable, because it is undoubtedly true that the great majority of fires result from the wilful ignorance or negligence on the part of constructor and occupier of buildings and their employees. In many instances these faults are of so gross a character as to be criminal, and numerous fires are caused dishonestly or maliciously.

The true interest of a nation requires that reliable information should be made public as to the direction in which human weaknesses and crime before referred to may be operating, and this fully as much with regard to fire as in the case of other disasters.

Fire insurance offices frame rating schedules and tariffs with the view of penalizing defects of construction, storage, manufacturing processes, and absence of due precaution which experience shows to be responsible for fires or cause increase of loss; but the manifest failure of existing provisions to do much toward lessening the loss of life and waste by fire proves that further provisions are needed to secure this desirable result. An investigation on the spot by a suitable officer into the causes of fires, carrying with it some expense or disability to the occupier of the premises where the fire occurred, would be more likely to obtain the end in view than any other course available.

When investigating the causes of fires, any damages resulting from the spread of fire from buildings first involved should also be investigated and specially tabulated, so as to definitely show the success or failure of provisions in existing building

regulations framed with the object of avoiding such "exposure" risk, pointing out where these regulations may need revision. It is claimed that tabulated information of this nature recorded in the Fire Marshal's reports of the City of Boston has proved to be of the greatest public advantage.

Annexed is a comparative statement of the principal causes of fires in several cities, so far as these are comparable. In any official return of the nature suggested the separate causes and extent of fires included under the different headings would be given in full detail, so as to call attention to special points of weakness, but even this table is sufficient to prove that the majority of fires are due to causes that are preventable, and also that fires resulting from acts of gross carelessness are increasing to an alarming extent.

Mr. SHEPPARD added—You will notice in the appendix, with regard to the record of fires in London for 33 years, those attributed to causes like throwing down lights, smoking, and things of that kind, which are distinctively acts of carelessness, have increased from 11.1 to 30.6. In some cases they exceed that—for instance, in Hamburg. If our friends from Hamburg are here, perhaps they will explain that. They classify it in a peculiar way, and it is difficult to bring it into line with our English record; 38.8 they make the percentage from gross carelessness. In Massachusetts they seem to reduce it to 27.2 per cent. I shall be very pleased to learn anything our friends have to say on this; it is a rather important subject.

DISCUSSION.

Dr. OTTO PRANGE (Secretary and Official Delegate of the German Fire Insurance Protection Association), spoke in German.

Police Investigate Fires in Germany.

The CHAIRMAN said—Dr. Prange reiterates what he stated the other morning, that in his city there is an official investigation by the police of every case of fire; that they go even so far as to prohibit the payment of any indemnity to the assured until the police have carefully investigated the fire, and while the police do not go into the question of the loss or the estimate of the loss, they take some cognizance of that fact. In the

case of every fire exceeding 50,000 marks (which would be about 10,000 dollars) in size, a careful investigation is made, and a tabulation and report on each fire is added to the statistics; the statistics, being based on a period of five years, carry with them very valuable information to the insurance companies. Of course, the statistics are not based on the question of insurance. I take it from the remarks of Dr. Prange that the investigation of the fires by classes of hazards is not undertaken.

Mr. J. P. GRAY (Official Delegate of the Boston Manufacturers' Mutual Fire Insurance Company) said—I wish to say a few words upon that. I am a firm believer that an investigation should be made by an experienced person. In Massachusetts we have that person. He has his corps of deputies, each deputy has a district in the State of Massachusetts, and on the occasion of a fire one of those deputies gets there as soon as possible and makes a close investigation; he reports to his chief in Boston, and, if necessary, a public investigation is made, and that is a matter of record; and from those records I understand that Mr. Sheppard has taken some of his figures. This system has worked admirably in Massachusetts, and has reduced our so-called incendiary fires very largely. As I said the other day at the meeting, it has sent quite a large number of people to the State's prison.

Investigation of Fires in Massachusetts.

We have here Mr. Curtis, who is associated with Mr. Russell, a fire commissioner in Boston. I think he can give us information as to what is the practice in Boston and Massachusetts as to reporting on fires.

Captain CURTIS—The fire records in the Boston department—and I think it is similar in other departments—show for each apparatus what work it does, and so on. Then the chief of the district in which a fire occurs reports to the Commissioner all the details of the building that is burned, even if the fire is slight; the probable cause; the time it occurred; the construction of the building, whether wood or brick; the number of stories that the fire passed through, and the amount of insurance and approximate loss. Those reports are then submitted to the protective department which is maintained by insurance

companies, and the losses are checked by them; the final losses being entered in the report at the fire headquarters, giving the proportion paid by the insurance companies; so that no matter where the fire occurs, it can always be found out what the damage was, what apparatus was used, and, as far as possible, the cause. If there is anything suspicious in the case the investigation is turned over to the fire marshal, who has power to investigate and punish; but if there is no suspicion, no further investigation is made.

Superintendent ELY (Fire Brigade, Leicester)—I can verify what the last gentleman has said with regard to the methods in Boston. I visited there last September and made close inquiry into their methods. But in this country the insurance companies, I am sorry to say, have not shown the sympathy with fire officers that they ought to have done.

In many cases where a fire officer has discovered what he considers a very suspicious fire the companies have compromised with the insured, and backed away, and relied on the public of the town, and the police authorities of the town, to fight their battle. I say that is (putting it in the most moderate language) cowardly on the part of the insurance companies. I have, in my experience, discovered a number of fires which were, without doubt, incendiary fires, and I have reported not only to the police, but to the insurance company.

The insurance company come along and compromise with the assured, perhaps pay him his premium back, and get the policy returned to them, and then, as far as they are concerned, they are not seen any longer, and they expect the local authority to prosecute the person who has made the fire. I maintain that that is not right or proper on the part of insurance companies. I know there is a dislike about it; they do not want it to be said that the company is fighing the assured; but at the same time, when there is a clear case of incendiarism, they ought to stand by the man who has discovered the incendiary, and not back out of it, and expect the police to spend the ratepayers' money in fighting their battles. I say that without hesitation, and I have discovered a number of incendiary fires in my experience. I think the companies ought to stand by the man who

Investigation of Incendiary Fires.

has made the discovery, and see the matter threshed out, and, if it is proved that the assured is a rogue, they ought not to pay the insurance money, but send the man to prison.

Mr. JAMES SHEPPARD—I am obliged to the last speaker for the remarks he has made. Insurance offices very naturally are disinclined to quarrel with their customers. I do not think that feeling is confined to insurance companies; but there is another question: as soon as an office takes action against any one, or resists an action to recover money, sympathy is aroused, and the jury invariably take the side of the assured, and the office is left in the lurch. I do not think it is for the companies to prosecute actions of this kind. It is police duty, and should be undertaken by the police. And the advantage to the public would be this: if you lower the number of fires in houses, and the losses they occasion, the public would have lower rates, and I think that is the action that should be adopted.

RESOLUTION.

The members of this Congress are strongly of opinion that in the public interest it is of the utmost importance that on the occurrence of every fire an investigation should be immediately made by an official, duly qualified and empowered to ascertain the cause and circumstance connected therewith, reporting the result of such investigation to a public department for tabulation and publication.

The whole or part of the cost of such inquiry to be charged to the occupier of the premises where the fire occurred, as may appear desirable in the circumstances of each case.

SECTION VI.

SUGGESTED STANDARDS OF FIRE RESISTANCE.

By Edwin O. Sachs, *Chairman British Fire Prevention Committee.*

The executive of the British Fire Prevention Committee, having given their careful consideration to the common misuse of the term "fireproof," now indiscriminately and often most unsuitably applied to many building materials and systems of building construction in use in Great Britain, have come to the conclusion that the avoidance of this term in general business, technical and legislative vocabulary, is essential.

The executive consider the term "fire-resisting" more applicable for general use, and that it more correctly describes the varying qualities of different materials and systems of construction intended to resist the effect of fire for shorter or longer periods, at high or low temperatures, as the case may be, and they advocate the general adoption of this term in place of "fireproof."

Further, the executive, fully realizing the great variations in the fire-resisting qualities of materials and systems of construction, consider that the public, the professions concerned, and likewise the authorities controlling building operations, should clearly discriminate between the amount of protection obtainable, or, in fact, requisite, for different classes of property. For instance, the city warehouse filled with highly inflammable goods of great weight requires very different protection from the tenement house of the suburbs.

The executive are desirous of discriminating between fire-resisting materials and systems of construction affording *temporary* protection, *partial* protection, and *full* protection against fire, and to classify all building materials and systems

of construction under these three headings. The exact and definite limit of these three classes is based on the experience obtained from numerous investigations and tests, combined with the experience obtained from actual fires, and after due consideration of the limitations of building practice and the question of cost.

The executive's suggested minimum requirements of fire-resistance for building materials or systems of construction will be seen from the standard tables appended for—

I. Fire-resisting floors and ceilings;

II. Fire-resisting partitions;

III. Fire-resisting doors;

—but they could be popularly summarized as follows:

(*a*) That temporary protection implies resistance against fire for at least three-quarters of an hour;

(*b*) That partial protection implies resistance against a fierce fire for at least one hour and a half;

(*c*) That full protection implies resistance against a fierce fire for at least two hours and a half.

The conditions under this resistance should be obtainable; the actual minimum temperatures, thickness, questions of load and the application of water, can be appreciated from the annexed tables by all technically interested, but for the popular discrimination—which the executive are desirous of encouraging—the time standard alone should suffice.

It is desirable that these standards become the universal standards in this country, on the continent and in the United States, so that the same standardization may in future be common to all countries, and the preliminary arrangements for this standardization are already in hand.

Suggested on behalf of the Executive.

THE BRITISH FIRE PREVENTION COMMITTEE,
EDWIN O. SACHS, *Chairman.*
ELLIS MARSLAND, *Hon. Secretary.*

THE BRITISH FIRE PREVENTION COMMITTEE.

STANDARD TABLE FOR FIRE-RESISTING FLOORS AND CEILINGS.

CLASSIFICATION.	Sub-Class.	Duration of Test at Least.	Minimum Temperature.	Load per Superficial Foot Distributed.	Minimum Superficial Area under Test.	Minimum Time for Application of Water under Pressure.
Temporary Protective Class.	A	45 mins	1,500° F.	Optional.	100 sq. ft.	2 mins.
	B	60 mins.	1,500° F.	Optional.	200 sq. ft.	2 mins.
Partial Protective Class.....	A	90 mins.	1,800° F.	1 cwt.	100 sq. ft.	2 mins.
	B	120 mins.	1,800° F.	1½ cwt.	200 sq ft.	2 mins.
Full Protective Class.....	A	150 mins.	1,800° F.	2 cwt.	100 sq. ft.	2 mins.
	B	240 mins.	1,800° F.	2½ cwt.	200 sq. ft.	5 mins.

STANDARD TABLE FOR FIRE-RESISTING PARTITIONS.

CLASSIFICATION.	Sub-Class.	Duration of Test at Least.	Minimum Temperature.	Thickness of Material.	Minimum Superficial Area under Test.	Minimum Time for Application of Water under Pressure.
Temporary Protective Class.	A	45 mins.	1,500° F.	2 in. and under.	80 sq. ft.	2 mins.
	B	60 mins.	1,500° F.	Optional.	80 sq. ft.	2 mins.
Partial Protective Class.....	A	90 mins.	1,800° F.	2½ in. and under.	80 sq. ft.	2 mins.
	B	120 mins.	1,800° F.	Optional.	80 sq. ft.	2 mins.
Full Protective Class.....	A	150 mins.	1,800° F.	2½ in. and under.	80 sq. ft.	2 mins.
	B	240 mins.	1,800° F.	Optional.	80 sq. ft.	5 mins.

STANDARD TABLE FOR FIRE-RESISTING SINGLE DOORS, WITH OR WITHOUT FRAMES.

CLASSIFICATION.	Sub-Class.	Duration of Test at Least.	Minimum Temperature.	Thickness of Material.	Minimum Superficial Area under Test.	Minimum Time for Application of Water under Pressure.
Temporary Protective Class.	A	45 mins.	1,500° F.	2 in. and under.	20 sq. ft.	2 mins.
	B	60 mins.	1,500° F.	Optional.	20 sq. ft.	2 mins.
Partial Protective Class.....	A	90 mins.	1,800° F.	2½ in. and under.	20 sq. ft.	2 mins.
	B	120 mins.	1,800° F.	Optional.	20 sq. ft.	2 mins.
Full Protective Class.....	A	150 mins.	1,800° F.	2½ in. and under.	25 sq. ft.	2 mins.
	B	240 mins.	1,800° F.	Optional.	25 sq. ft.	5 mins.

Mr. SACHS—My paper is really not one that lends itself very much to what I may call reading, and also, it is not my paper as is generally understood if a man reads a personal paper. What I have to read to you is the result of many conferences of the members of the Executive of the British Fire Prevention Committee as to suggested standards of fire resistance. The Executive met on that subject more than a dozen times, and it was with the greatest diffidence that they put together the ideas that are now embodied in this paper. What they really desire most is that the principle which they put forward shall be recognized at this Congress, with the view of strengthening the hands of those who conduct testing operations, not only in our country, but elsewhere, and to try to systematize the various methods of testing and the principles of testing both at home and abroad. What we are really trying to arrive at is this, as I explained in my opening address: That when Mr. Jones tests in the United States or Mr. Smith tests in Canada, those tests, by means of a testing station affiliated to a common central bureau, shall be on identical lines with the tests conducted at our testing station, which you saw yesterday afternoon, and that when the manufacturer comes with his wares into this country, or into Germany or France, or

wherever it may be, the architect and the building owner will know approximately how the material is to be relied upon. Another point we want to bring out is this (which I also touched upon in my opening address)—the cancellation of the word "fire-proof" from technical literature and in legislation.

At a Congress of this kind resolutions in detail are never advisable; but I think it would be safe to propose that in the first place the Executive's aim in abolishing the word "fire-proof" from technical literature, and so forth, accords with the feeling of the Congress, and is strongly recommended; secondly, that the word "fire-resisting" for technical literature and for legislation is the correct word; thirdly, that it would be well to discriminate between the class of fire-resistance as temporary resistance, partial resistance and full resistance; and lastly, that it is eminently advisable that the standards of one country should be brought in line with the standards of other countries. So far as standards are concerned, there is not the slightest reason why they should not apply to all countries. The only other point—and it is a small practical point—is that of the description of temperatures, weights, etc. It is the intention of the Fire Prevention Committee, after this Congress, to put temperatures both in Centigrade and Fahrenheit degrees, to put weights both in grammes and in pounds, and measures both in metres and in feet, so that what we do here may be understood elsewhere. This method will be adopted by Mr. Press at St. Petersburg and by Mr. Havestadt in Germany; and we hope to be able to persuade our American friends to do the same.

Mr. F. JAFFÉ (Crown Architect, Berlin)—I think the idea elaborated in Mr. Sach's paper is a splendid one, and I see no reason why it should not be accepted. As in electricity and in other branches of technical science, a standard scale is necessary, also in dealing with fire-resisting material. I think we have to thank Mr. Sachs very much for bringing forward this plan, and for my part I very cordially support its adoption.

Major H. HULEATT, R. E. (War Office)—While agreeing in all that has been said about the value of this paper and the excellence of the suggestions made, I want to express satisfaction with it on a rather different ground. I think it is a very

great step in advance, upon which I congratulate the Executive, that they should recognize partial protection. It has constantly been my difficulty, in connection with other matters, that when you have an expert he will order certain things that are quite impracticable, and when you suggest something less he will say you must go the whole hog or nothing at all. It may be very difficult to persuade a building owner to go to the expense of providing what we mean by full protection, but it is a step in advance if we recognize that we may advocate partial or temporary protection. I confess that I attach very great importance to this question of temporary protection. I have had some experience with fires, and we know that it makes all the difference if you can hold a fire for three-quarters of an hour. The expense of providing partial or temporary protection may be comparatively slight, and the owner may be got to agree to it, where the costly provision of full protection would be out of the question.

Value of Temporary Protection.

GENERAL MEETING.

THE NEED FOR A UNIFORM METHOD OF TESTING THE FIRE RESISTANCE OF BUILDING MATERIALS.

By Commandant Welsch, *Chief Officer of the Ghent Fire Brigade.*

Summary.

In this paper Commandant Welsch stated that the very slow rate of progress in the application of fire preventive measures was owing to the indifference of governments in general; the inadequacy of building laws and regulations and of the rules for the handling, storage, etc., of dangerous materials; the incomplete education of our engineers and architects in the direction of fire prevention; the too elementary training of a large number of fire brigade officers; the inefficient organization of the fire insurance service; the indifference, carelessness and ignorance of employers of labor and the general public; the lack of data as to the fire resistance of building material owing to the want of the necessary testing stations in different parts of the world.

Mr. Edwin O. Sachs in the Chair.

Mr. Edwin O. Sachs—Gentlemen: The six sections of the Congress have finished their deliberations. Some of the sections, I am happy to say, were particularly well attended and have had most animated discussions. That refers very particularly to section II., "Electrical Safeguards and Fire Alarms," and to section I., "Building Construction and Equipment." In nearly every case the gentlemen who had so kindly prepared their papers were able to present the same in person,

but in one or two cases, where they were unavoidably prevented from coming, the papers were read for them.

In most of the sections resolutions appear to have been proposed in connection with individual papers that were read. Some of those resolutions were taken unanimously, as they stood, others were amended, sometimes slightly, sometimes materially. Now for the resolutions, so far as I have been able to collect them in time for this meeting.

I now propose for the purpose of the Congress that each sectional resolution be adopted by the Congress as a whole, but that should any amendment be desired, such an amendment be immediately handed in.

Mr. Sachs then read the resolutions as they have been passed by the sections.

The CHAIRMAN—In connection with the resolution on Testing Stations, I am happy to say that I believe I have already, in consultation with Mr. Welsch and other gentlemen, been able to arrange for the formation of the International Technical Bureau, particulars of which will, I think, be announced shortly. The idea is that the International Technical Bureau shall be comprised of gentlemen representing institutions, committees and societies interested in the constructional and experimental side of our work, and we hope to be able to arrange not only to make this Bureau representative of Europe, but to include our American friends, for in America, as you all know, there is a very fine testing station which has been organized by the tariff officers committee, with which Mr. Hexamer is connected, and another testing station has been started, after the visit of Mr. Atkinson to England last year, under the directions of the Mutual Fire Insurance Co., with which Mr. Gray is associated.

Mr. GRAY—I will state that the last named experimenting station is not solely a mutual station, because part of the money has been subscribed by the stock insurance companies for the purpose. It is more a national station, and will be in connection with the Massachusetts Institute of Technology, and made a study in that institution.

The CHAIRMAN—Mr. Press has come over from St. Peters-

burg with a view of getting his proposed testing station into line with our own. We have representatives here from other countries equally interested. It will be a small working bureau, and we hope in time it will develop into a recognized technical bureau on the subject.

In respect to building legislation and fire resisting materials, it is well known that many of the building acts and building regulations, both at home and abroad, are not up to date with the results of actual investigation, and I think it would be to the benefit of the various municipalities concerned if they were brought up to date.

In respect to technical education, I may say that curiously enough I cannot trace a single course of lectures in any technical college at home or on the Continent (though I understand there are one or two in America) where students of architecture and engineering—the coming architects and engineers—are given distinct instruction on the subject of fire resistance. It seems left out everywhere. I understand that one of the technical institutions in America has started it, and I hope that the same model will be adopted in other colleges, and certainly in the new London " Charlottenburg," which we all hear so much about at present.

In conclusion, gentlemen, I beg to move from the Chair that both the general resolutions already passed and the sectional resolutions adopted by the sections be together approved and adopted, with accepted amendments, by the Congress as the Congress Resolutions of the International Fire Prevention Congress of 1903.

Mr. C. HEXAMER (President of the National Fire Protection Association, U. S. A.) said—It is a little difficult for me to rise to support the whole of the resolutions, as, unfortunately, from the arrangements of the sectional work, some of the most important resolutions were proposed and acted upon by those sections without the possibility of a general discussion. I can see the difficulty of taking every one of the resolutions that have been passed and again submitting it to the Congress, for possibly it would take two or three days. On the whole I think, however, that I can fully support all the amended reso-

lutions that have been proposed in the different sections, and I shall be satisfied to second the proposition that the vote on the resolutions of the general meetings and of the various sections be together considered the final resolutions of the Congress.

The CHAIRMAN—It is proposed from the Chair and seconded by Mr. Hexamer, that the general and sectional resolutions be approved and adopted together as Congress resolutions. Is it your favor that that be so?

The resolutions were carried unanimously.

Resolutions of thanks were then proposed expressing the sincere appreciation of the Congress for the untiring efforts of the Chairman, Mr. Edwin O. Sachs, and General Secretary, Mr. Ellis Marsland, which had contributed so largely in making the Congress such a splendid success. These resolutions were indorsed in fitting terms by the delegates from America, Germany, France, Russia, Hungary, etc.

The resolutions were passed by rising vote, accompanied by loud applause.

RESOLUTIONS.

The following are the resolutions adopted unanimously by the Congress:

APPROXIMATE WORDING.

Re the term "Fireproof."

The Congress having given their consideration to the constant misuse of the term "fireproof," and its indiscriminate and unsuitable application to many building materials and systems in use, have come to the conclusion that the avoidance of this term in the general business and technical vocabulary is essential.

Re the term "Fire-resisting."

The Congress consider the term "fire-resisting" more applicable for general use, and that it more correctly describes the varying qualities of the different materials and systems of construction intended to resist the effect of fire for shorter or longer periods at high or low temperatures, as the case may be; and they advocate the general adoption of this term in the place of the term "fireproof."

Re Standards of Fire Resistance.

The Congress confirms the British Fire Prevention Committee's proposed standards of fire-resistance and hereby resolves that the universal standards of fire-resistance shall in future be:

1. Temporary protection;
2. Partial protection;
3. Full protection;

in accordance with the committee's schedule.

Re the Metric System.

The Congress considers:

That in all reports dealing with questions of fire-resistance and tests, the metric system of measurement, weight and temperature shall be adopted as well as any local system.

Re " Testing Stations."

The Congress strongly recommends the establishment of testing stations for fire-resisting materials and the adoption of a universally recognized method of testing; also the formation of a permanent International Technical Bureau, which shall meet at suitable periods to discuss, fix, and from time to time modify the methods of testing.

Re Fire-resisting Materials and Building Legislation.

The Congress considers it essential to revise from time to time local building regulations to accord with the results obtained by the investigation of fire-resisting materials and methods of construction.

Re Technical Education.

The Congress considers it essential that courses of study should be provided in universities, technical colleges and schools for the instruction of engineering and architectural students in the fire-resistance of building materials and the methods of construction as based on investigation.

Re Insurance Influence on Fire Prevention.

The Congress considers that the Factory Mutual Insurance System, as adopted in the United States, materially tends to the prevention of fire and the reduction of fire waste.

Re the Legal Status of Fire Brigades.

The Congress considers it most necessary that fire brigades be placed on a sound legal basis, and that it is advisable that their efficiency be supervised by a government department.

Re Lightning.

The Congress considers that having regard to the neglect of precautions against damage caused by lightning, the subject should have the serious consideration of the Government and local authorities, the technical professions and the fire service.

Re Fire Brigades and Fire Prevention.

The Congress considers that the public authorities should encourage their fire brigade officers to take an active interest in the preventive aspect of fire protection, inasmuch as the result of the fire brigade officers' experience in actual fire practice, if suitably applied in conjunction with the work of architects, engineers and public officials, would be most useful for the organization and development of precautionary measures.

The Congress considers it of importance that its fire brigade societies, associations and unions, shall henceforth encourage among the brigades affiliated to these bodies the study of questions of fire prevention.

Re Records.

The members of this Congress are strongly of opinion that in the public interest it is of the utmost importance that on the occurrence of every fire an investigation should be immediately made by an official, duly qualified and empowered to acsertain the cause and circumstance connected therewith, reporting the result of such investigation to a public department for tabulation and publication.

The whole or part of the cost of such inquiry to be charged to the occupier of the premises where the fire occurred, as may appear desirable in the circumstances of each case.

Re Publication of Technical Fire Reports.

The Congress considers it advisable that the Press should from time to time publish technical reports on fires so that the public may benefit from the knowledge and experience gained.

Re Maintenance of Private Fire Appliances.

The Congress considers that greater attention should be accorded to the maintenance of private fire appliances where installed to meet local or insurance requirements.

Re Fire Insurance Rating.

The Congress considers that a system of fire insurance rating which does not discriminate between safe and unsafe construction, and between carefulness and negligence, is an injury to the community.

Re Theatre Safety.

The Congress considers:

1. That the first essential for the safety of the public attending theatres is the provision of easy means of exit from the auditorium by *direct* and clear routes of exit as distinct from circuitous routes.

2. That next in importance to the provision of exits, the safety of the public requires the provision of suitable fire watches and careful fire survey with the view to the prevention of fire.

3. That the safeguard third in the scale of importance is the provision of automatic sprinklers over the stage.

4. That questions of suitable construction, fitting, and equipment only rank after the above three primary safeguards for the protection of the public.

5. That with the view of furthering the prevention and extinction of fires, fire watches in theatres should be manned from the public fire service.

6. That it is desirable to either provide the necessary movable fire appliances of a theatre from the public fire service, or to have powers to enforce uniformity of pattern and quality.

7. That theatres require a duplicate water supply service.

Re Spontaneous Combustion.

The Congress considers that the dangers of spontaneous combustion are such as to make it essential for manufacturers, warehousemen, shipowners, and others, to receive warnings from time to time as to the latest experience obtained and the precautionary methods advisable, and that reports upon instances of spontaneous combustion should be collected and summaries published at a recognized centre.

Re Consolidation and Uniformity in Legislation.

The Congress considers that the consolidation of fire preventive and fire protective legislation is essential in all countries.

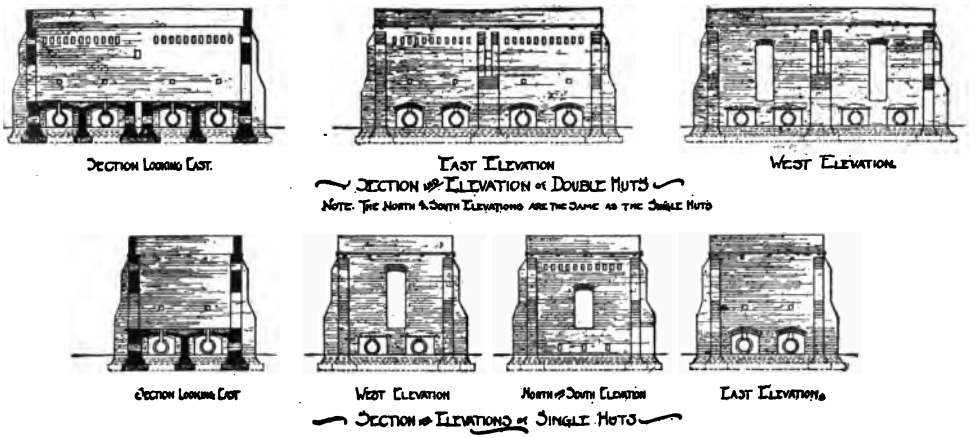
The Congress considers that every government should embody the primary requirements of fire prevention and protection in a Fire Act, leaving local regulations to be drafted by local authorities to meet local requirements, such regulations, however, to be based upon model by-laws embodying fundamental principles and serving as a guide towards uniformity in the requirements for public safety.

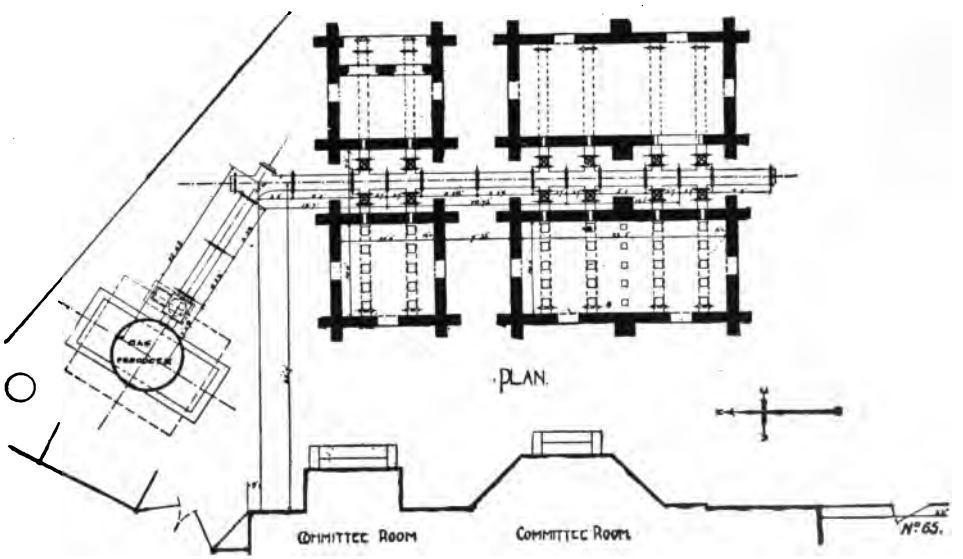
Re International Publications.

The Congress considers that the Technical Commission of the International Fire Brigades Council and the British Fire Prevention Committee conjointly, be requested to consider the possible publication in three languages (English, German and French) of technical experience obtained at fires as an international publication or journal.

The British
Fire Prevention Committee's
Testing Station

DIAGRAMS AND VIEWS





GENERAL PLANS AND SECTIONS OF THE TESTING CHAMBERS.

DIAGRAMS ILLUSTRATING DESCRIPTION OF THE BRITISH FIRE PREVENTION COMMITTEE'S TESTING STATION.

GENERAL VIEW OF NEW TESTING STATION OF THE BRITISH FIRE PREVENTION COMMITTEE, NEAR WESTBOURNE PARK.

ONE OF THE BRITISH

Floor composed of 2½ in. I

INTERIOR OF TEST BUIL

View during the test, which

OUTSIDE VIEW OF TIN-COVE

INSIDE VIEW OF TIN-COVERED